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THE

TUTOR's GUIDE,

BEING

A Complete Syſtem of Arithmetic;

WITH

Various Branches in the MATHEMATICS.

IN SIX PARTS, *VIZ.*

I. Arithmetic in all its uſeful Rules, and to each a great Variety of Queſtions.

II. Vulgar Fractions, in all their Parts.

III. Decimal Fractions, with the Extraction of Roots of different Powers; to which are added, Rules, &c. for the eaſy Calculation of Intereſt and Annuities, &c.

IV. Menſuration of Superficies and Solids, applied to meaſuring Artificers Work, &c. with a Collection of Queſtions for Exerciſe. To which is added, the ſpecific Gravity of Metals, &c.

V. Chronology, or the Method of finding the ſeveral Cycles, Epacts, Moveable Feaſts, Time of High Water, &c. with a Collection of Queſtions relating to Hiſtory; likewiſe all the moſt uſeful Examples on both the Globes.

VI. Algebra, wherein the Method of raiſing and reſolving Equations is rendered eaſy, and illuſtrated with Variety of Examples and Numerical Queſtions.

TO WHICH IS ADDED,

AN APPENDIX.

Containing different Forms of Acquittances, Bills of Exchange, &c. &c.

The whole being deſigned for the Uſe of Schools, as a QUESTION BOOK, or a REMEMBRANCER and INSTRUCTOR to ſuch who have ſome Knowledge of Figures, and is adapted for the Uſe of the Gentleman and Scholar, as well as for the Man of Buſineſs: And is recommended by ſeveral eminent Mathematicians and School-maſters.

The SIXTH EDITION, corrected and improved, with Additions.

By CHARLES VYSE,

Author of the Young Ladies' and Gentlemen's New Guide to the Engliſh Language, &c. and Maſter of the Academy at Weſt Ham Abbey, Eſſex.

LONDON:

PRINTED FOR G. G. J. AND J. ROBINSON, PATER-NOSTER-ROW.

MDCCLXXXV.

Chas. Austen Jaques.

The MONTHLY REVIEW, *for January* 1771, *gives the following Account of the* first *Edition.*

"The beſt Method of conveying Inſtruction is derived from Experience: and though the Author of the TUTOR's GUIDE does not pretend to boaſt of new Diſcoveries, yet it muſt be allowed, that he has ſelected a great Variety of neceſſary and uſeful Rules for the obtaining a thorough Knowledge in thoſe Sciences which depend upon Arithmetic: And his Book will be found particularly uſeful in this Reſpect, as it contains a very conſiderable Number of Queſtions to exemplify the Rules he has laid down, and to exerciſe the Attention of the Learner.—Many of them may be thought to ſurpaſs the Capacity of young Scholars; but this Circumſtance is no juſt Objection againſt the Book itſelf; it rather recommends the Work to an after Review, when the Underſtanding is enlarged and ripened. The Plan and Execution of Mr. Vyſe's Performance do Honour to his Judgment and Application, and entitle it to the general Notice of thoſe who are entruſted with the Education of Youth."

The CRITICAL REVIEW *gives the following Account.*

"Notwithſtanding there are many Books already extant, upon the ſame Subject, yet we apprehend that the Work before us will not be deemed either unneceſſary or impertinent, after having aſſured our Readers, it is recommended to the Favour of the Public by one of the moſt conſiderable Mathematical Writers of the preſent Age."

TO THE

REVEREND MR. VYSE,

Archdeacon of SALOP,

Canon Residentiary of the Church of LICHFIELD,

And Rector of St. Philip's Church in BIRMINGHAM,

THIS

SYSTEM OF ARITHMETIC

IS,

With the utmost Deference,

Inscribed by,

His most obliged humble Servant,

CHARLES VYSE.

09-10-35 MLR

Hist of Sci
Lyman
8-19-35
30838

THE

PREFACE.

WHEN we consider the Utility of ARITHMETIC, on which Science almost all the others do absolutely depend, we need not be surprised that so many Efforts have been made to bring this useful Branch of Learning to the utmost Degree of Perfection: and although the vast Extent of the Subject does in some Measure defeat these Attempts; yet, upon Account of its real Value and Use, it certainly merits all the Study and Pains that can be bestowed upon it.

In the following Pages I have delivered the Definitions and Rules in as brief and concise a Manner as I possibly could, so as to make them general; and they follow in the same Order as specified in the Table of Contents: Thus, Book the First contains the four primary Rules, *i. e.* Addition, Subtraction, Multiplication, and Division, in Integers, and Reduction, ascending and descending, with the Tables of Money, Weights, Measures, &c. with which the Pupil should be well acquainted, before he proceeds to the Use of those Rules in Compound Numbers.

In Book the Second, the Rules follow in the same Order in which they are generally taught

in Schools; but I apprehend the moſt expeditious Method for the Pupil would be to learn as far as the Rule of Three, then Vulgar and Decimal Fractions, the Extraction of the Square and Cube Roots; after which a larger field may be opened to him, as he will be more capable to judge for himſelf, and (with a little Aſſiſtance from the Maſter) go through any Rule, to his own Satisfaction and his Teacher's Honour. But in Schools the Maſter very ſeldom either knows the Buſineſs for which his Scholars are deſigned, or the Length of Time they are to continue at School, and is therefore obliged to purſue the old beaten Path, and teach them firſt, what is not perhaps the moſt eſſential.

In this Work, amongſt ſeveral hundred Queſtions, are all thoſe moſt excellent ones of the late MARTIN CLARE, ranged according to the ſeveral Rules to which they appertain, a Thing wiſhed for by School-maſters and Teachers in general.

I pretend not to boaſt of new Diſcoveries, but flatter myſelf to have ſelected every neceſſary and uſeful Rule or Propoſition for obtaining a thorough Knowledge in thoſe Sciences which depend upon Arithmetic; and have given a great Variety of ſuch Queſtions as will enable the Tutor to ſupply his Pupils with thoſe that may be moſt conducive to the Station of Life for which they may be deſigned.

I have ſelected the moſt difficult Queſtions of each Rule, as Exerciſes for leiſure Hours.

And,

And, in order to make this Book as uſeful as poſſible, I have added ſeveral examples of the different Forms of Acquittances, Promiſſory Notes, Bills of Exchange, Bills of Parcels, &c. the frequent copying of which I would recommend to the Pupil.

I have not adjoined the Anſwers to the Queſtions, as I have publiſhed (by Deſire of ſeveral Mathematicians and School-maſters), a KEY to the TUTOR'S GUIDE, wherein all the Anſwers are worked at Length, with proper References to the Queſtions as they ſtand in this Edition.

I need not point out the great Utility of ſuch a Performance; it is ſufficiently evident to all who are employed in this Branch of Education, eſpecially ſuch as have the Care of a numerous School, and experience the Difficulties that Teachers in general labour under with Reſpect to Time; a Grievance that muſt ſtill continue, while the Prices they receive are ſo very inadequate to their Labours.

I hope the Gentlemen of the Profeſſion will do me the Juſtice to believe, that my Deſign in this Performance was not to dictate to, but eaſe the Maſter; and the ſkilful Teacher will, no Doubt, vary the Work of the Queſtions according to the Nature of the ſeveral Rules.

The TUTOR'S GUIDE and its KEY furniſh a Complete Syſtem of ARITHMETIC, and will enable thoſe, who are acquainted with the firſt Principles, to attain (without the Aſſiſtance of a Maſter) a competent Knowledge of the ſeveral Rules with Eaſe and Preciſion.

By

By the particular Deſire of many eminent School-maſters, an Abridgement of the GUIDE is publiſhed with this Addition, entitled the YOUNG ARITHMETICIAN'S ASSISTANT; wherein is contained only what is moſt immediately neceſſary for the lower Forms, and thoſe deſigned for Trade or Buſineſs; the Guide being thought too expenſive to put in the Hands of young Beginners, therefore put it out of the Power of many Maſters, particularly thoſe who keep Day Schools, to make uſe of in their Schools. The Abridgement has the ſame Advantage with reſpect to the Key as the Guide.

The favourable Reception the former Editions have met with gives me Room to hope, that the Alterations and Additions I have made in this, will merit the Approbation of thoſe Gentlemen who have kindly intereſted themſelves in Behalf of my former Endeavours, to whom I return my moſt ſincere Thanks, and am,

With the utmoſt Eſteem and Reſpect,

Their's and the Public's much obliged,

obedient humble Servant,

WEST HAM ABBEY, 1785. } CHARLES VYSE.

THE

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EXPLANATION *of the* CHARACTERS *made Use of in this* BOOK.

Signs.	Names.	Significations.
+	*Plus*, or *more*,	The Sign of Addition, as 6+2 is 8.
—	*Minus*, or *leſs*,	The Sign of Subtraction, as 6—2 is 4.
×	*Multiplied into*, or *by*	The Sign of Multiplication, as 6×2 is 12.
÷	*Divide by*	The Sign of Diviſion, as 6÷2 is 3.
=	*Equal to*	The Sign of Equality, as 6+2=8.
: ::	*Is to* / *So is*	The Signs of Proportionals, as 2 : 4 :: 6 : 12.
√	*Extraction of the Roots.*	The Square Root of 9=3 is $^{2}\sqrt{9}=3$, and the Cube Root of 8=2 is $^{3}\sqrt{8}=2$.

6—4×9=18; Signifies, that 6 leſs 4 multiplied by 9=18.

The Twelve SIGNS of the ZODIAC.

♈ Aries, the Ram.
♉ Taurus, the Bull.
♊ Gemini, the Twins.
♋ Cancer, the Crab.
♌ Leo, the Lion.
♍ Virgo, the Virgin.
♎ Libra, the Balance.
♏ Scorpio, the Scorpion.
♐ Sagittarius, the Archer.
♑ Capricornus, the Goat.
♒ Aquarius, the Waterbear.
♓ Piſces, the Fiſhes.

THE

THE

TUTOR's GUIDE,

BEING

A Complete Syſtem of Arithmetic.

BOOK I.

Arithmetic in whole and compound Numbers.

1. INTRODUCTION.

ARITHMETIC is the Science, or Knowledge of Numbers, which is either Unit, or Multitude of Units.

Unit is any Thing conſidered as one, or 1.

Digits, or Figures, are the Marks by which Numbers are denoted or expreſſed, and are the nine following, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9; with theſe there is uſed the Mark 0, called a Cypher, which of itſelf ſtands for nothing, but being annexed to the Right-hand of a Digit, alters its Value, thus 40 ſignifies forty, and 400 ſtands for four hundred, &c. (See the following Table.)

Integers, or whoſe Numbers are ſuch as expreſs a Number or Multitude of Things, whereof each is conſidered as an Unit. Thus, 6 Pounds, 12 Yards, 140 Miles, &c. each of which is called an Integer, or whole Number.

Compound Numbers are ſuch as conſiſt of different Denominations, as Pounds, Shillings, Pence, and Farthings; or Hundreds, Quarters, Pounds, Ounces, &c.

Thus, 47l. 12s. 6¼d. or 4 C. 2 qrs. 14 lb. &c.

A Fraction, or broken Number, is always leſs than Unit, as $\frac{3}{4}$ repreſents three Quarters of any Thing or Unit, and $\frac{6}{8}$ is ſix-eighths of Unit or 1, &c.

Arithmetic, with regard to Art and Science, conſiſts both in Theory and Practice.

Theory conſiders the Nature and Quality of Numbers, and demonſtrates the Reaſon of Practical Operations.

The Practice is that which ſhews the Method of working by Numbers, ſo as to be the moſt uſeful and expeditious for Buſineſs, and has five principal or fundamental Rules for the Operation, viz.

1. NUMERATION or NOTATION. 2. ADDITION. 3. SUBTRACTION. 4. MULTIPLICATION. And, 5. DIVISION.

1. NUMERATION

TEACHETH to read, or expreſs the true Value of any Number when writ down; and conſequently to write down any propoſed Number according to its true Value; and this conſiſteth of two Parts.

1. The due Order of placing down Figures.

2. The true valuing of each Figure in its Place, both of which are plainly exhibited in the following

TABLE.

9 Hundred of Millions.	8 Tens of Millions.	7 Millions.	.	6 Hundred of Thouſands.	5 Tens of Thouſands.	4 Thouſands.	.	3 Hundreds.	2 Tens.	1 Units.
4	0	0	.	0	0	0	.	0	0	1
	4	0	.	0	0	0	.	0	0	0
		4	.	0	0	0	.	0	0	0
				4	0	0	.	0	0	0
					4	0	.	0	0	0
						4	.	0	0	0
								4	0	0
									4	0
										4

EXAMPLES.

Write down the Value of the following Numbers, in Words at length, viz. 94, 762, 3024, 37460, 142613, 6040390, 47639121, 790401950, and 79041955.

In Figures expreſs

Seventy-ſeven. Four hundred and ninety. Six thouſand and fifty-five. Seventeen thouſand ſeven hundred and nine. Eight hundred thouſand and two. Seven millions forty-four thouſand and ſeventy-four. Six hundred Ninety-four millions. Four hundred thouſand and ſixty.

NOTATION.

By ROMAN *Numerical Letters.*

One, five, ten, fifty, hundred, five-hundred, thouſand.
I, V, X, L, C, D, M.

When a leſs numerical Letter ſtands before a greater, it muſt be taken from it, as I before V or X, and X before L or C, &c. Thus,

four, nine, forty, ninety, &c.
IV, IX, XL, XC.

When a leſſer numerical Letter ſtands after a greater, it is to be added to it. Thus,

ſix, eleven, ſixty, one hundred and ten.
VI, XI, LX, CX.

A Line drawn over any Number leſs than a Thouſand, ſignifies ſo many Thouſands, as $\overline{LX}$, is ſixty Thouſand, $\overline{C}$ is one hundred Thouſand, $\overline{M}$, is one Million, &c.

Write down in common Figures the following Numbers expreſſed in Numerical Letters, viz.

XIX, CC, DC, DLX, MI, MDCCL, $\overline{LXX}$, $\overline{CX}$, $\overline{MD}$, $\overline{MDC}$.

Write down in numerical Letters the following Numbers expreſſed in common Figures, viz.

29, 104, 419, 1741, 2007, 17678, 10004, 674084.

2. INTEGERS.

ADDITION

TEACHETH to add ſundry Numbers together into one Sum, called the Total.

RULE.

1. Place all the Numbers of a like Name under one another, that is, units under units, tens under tens, hundreds under hundreds, &c.

2. Begin with the Units, and ſingly collect the Sum of each Row, and if their Sum be leſs than ten, ſet it down underneath its own place; but if it exceeds ten, the Exceſs is only to be ſet down, carrying one for every ten to the next Row, and ſo on, continuing to the laſt Row, at which ſet down the total Amount.

PROOF.

Vary the adding, by beginning at the Top of the Sum, and reckon the Figures downwards, in the ſame Manner you added them upwards, and if the Sum comes the ſame as before, it is ſuppoſed to be right.

TABLE of ADDITION,

Which is to be got by Heart, by thoſe who are Beginners in this Science.

0	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	—	4	5	6	7	8	9	10	11
3	—	—	6	7	8	9	10	11	12
4	—	—	—	8	9	10	11	12	13
5	—	—	—	—	10	11	12	13	14
6	—	—	—	—	—	12	13	14	15
7	—	—	—	—	—	—	14	15	16
8	—	—	—	—	—	—	—	16	17
9	—	—	—	—	—	—	—	—	18

The manner of uſing the Table is thus: Take the greater of the two Digits, whoſe Sum is ſought, in the upper Line, and the leſſer on the Left-hand Column, in the ſame Line with this, and underneath the other ſtands the Sum.

As ſuppoſe I wanted the Sum of 9 and 7, then I look for 9 on the Head of the Table, and in the ſame Line with 7 on the Side ſtands 16, the Sum.

EXAMPLES.

EXAMPLES.

(1)	147279	(2)	176042	(3)	127492
	274042		47976		274614
	716914		274		27406
	472196		4		274
	417417		471472		24
	194746		469		4158
(4)	147747	(5)	2147426	(6)	174684
	74774		2749		147129
	2467		275		2984
	915		3746		100
	20		74		63
	6		2147		1074
(7)	174264	(8)	14768412	(9)	174684
	7416		2131596		26276
	271		29418		174168
	147419		274		276
	4176		71471041		7
	47		219816		741705
	7913		1427		27417
	274		70		3570

3. SUBTRACTION

TEACHETH to take a leſſer Number from a greater, and thereby ſhews the Difference or Remainder.

RULE.

1. Place your Numbers according to the Direction given in Addition.

2. Begin at the Right-hand, and ſubtract each under Figure, from that which ſtands over it, writing each Remainder

mainder under which it proceeds from, ſo ſhall all the Remainder together expreſs the Difference required.

3. But when the under Figure exceeds that which ſtands over it, you muſt borrow ten (the ſame which you ſtopped at in Addition) from which take the lower Figure, and to that difference add the upper Figure and the Sum ſet down, always remembering to carry or add one to the next Figure on the Left-hand, before you ſubtract.

PROOF.

To the leſſer Number add the Remainder, if the Sum be like the greater the Work is right.

TABLE of SUBTRACTION.

c	1	2	3	4	5	6	7	8	9
1	0	1	2	3	4	5	6	7	8
2	—	0	1	2	3	4	5	6	7
3	—	—	0	1	2	3	4	5	6
4	—	—	—	0	1	2	3	4	5
5	—	—	—	—	0	1	2	3	4
6	—	—	—	—	—	0	1	2	3
7	—	—	—	—	—	—	0	1	2
8	—	—	—	—	—	—	—	0	1
9	—	—	—	—	—	—	—	—	0

The manner of uſing this Table is the ſame with that of Addition, only, inſtead of adding the Digits together, ſubtract them.

EXAMPLES.

(1) From 1472742
Take 1251620
Rem.
Proof

(2) 1704941
807467

(3) 17406542
16716746

(4) Bought 10768475
Sold 7607485
Rem. unſold

(5) 2074176
1760184

(6) 7417065
4708095

(7) From

(7)	From	10746142	(8) 12468409	(9)	2170684
	Take	1786076	9147608		1100787
	Rem.				

(10)	From	106742740	(11)	214200040
	Take	74760946		107400760

4. MULTIPLICATION

TEACHETH how to increase any one Number by another, so often as there are Units in that Number by which the one is increased; and serves instead of many Additions.

To this Rule belong three principal Members, viz.

1. The Multiplicand, or Number to be increased or multiplied.

2. The Multiplier, or Number by which the Multiplicand is increased or multiplied.

3. The Product, or Number produced in multiplying.

Note.—Before any Operation can be performed in this Rule, it is absolutely necessary that the following Table be got by heart; as the ready Performance of this and all the following Rules, entirely depends upon having a perfect Knowledge of it.

TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	—	9	12	15	18	21	24	27	30	33	36
4	—	—	16	20	24	28	32	36	40	44	48
5	—	—	—	25	30	35	40	45	50	55	60
6	—	—	—	—	36	42	48	54	60	66	72
7	—	—	—	—	—	49	56	63	70	77	84
8	—	—	—	—	—	—	64	72	80	88	96
9	—	—	—	—	—	—	—	81	90	99	108
10	—	—	—	—	—	—	—	—	100	110	120
11	—	—	—	—	—	—	—	—	—	121	132
12	—	—	—	—	—	—	—	—	—	—	144

USE

USE of the TABLE.

Seek the greater of the two Digits in the upper Line, and underneath it againſt the leſſer, taken in the Left-hand Column, is the Product ſought. Thus, to multiply 9 by 6, ſeek 9 in the upper Line, and under it againſt 6 on the left is 54, the Product; and ſo of any other.

Note.—For the Conveniency of dividing by 11 or 12, I have continued the Table to 12 Times, or elſe in Multiplition it is only required to 9 Times.

CASE I.

To multiply by a Single Figure.

RULE.

1. Place the Multiplier underneath the Units Place of the Multiplicand.

2. Multiply the Units Figure of the Multiplicand by the Multiplier, if their Product be leſs than ten, ſet it down under its own Place of Units; but if their Product exceeds ten (or tens), then ſet down the Exceſs only (as in Addition) and bear (or carry) the ſaid ten (or tens) in Mind, until you have multiplied the next Figure of the Multiplicand by the ſame Figure of the Multiplier, and to their Product add one for each ten borne in Mind, ſetting down the Exceſs of their Sum above ten (or tens) as before; and ſo proceed in the ſame Manner until all the Figures of the Multiplicand are multiplied by the Multiplier.

PROOF.

The moſt ſure and unerring Way is by Diviſion:—But as the Learner is ſuppoſed not yet to know that Rule, cannot prove by it; let him therefore make the Multiplicand the Multiplier, and if the Product comes out the ſame as before, the Work is right.

Some Maſters that teach (and ſeveral Authors that write of) Arithmetic, prove Multiplication by the Croſs. But this Method is not to be depended upon, as it will prove a Sum to be right, when at the ſame Time the work is utterly falſe. But it will not prove a Sum falſe that is right.

(1) Mul-

(1) Multiplicand 417609853
Multiplier 2
Product

(2) 342719086
3

(3) 257680914
4

(4) 174205683
5

(5) 170965381
6

(6) 749185603
7

(7) 262758094
8

(8) 376290845
9

CASE II.

When the Multiplier consists of several Figures.

RULE.

1. Place each Figure in the Multiplier respectively under its own kind in the Multiplicand.

2. Multiply the Multiplicand by each Figure of the Multiplier (as before), observing to place the first Figure of each respective Product underneath that Figure of the Multiplier, by which you multiply with.

3. Add the several Products together, and the Sum will be the desired (or whole) Product.

EXAMPLES.

(9) 142737396
16

(10) 21607472
28

(11) 12076849
97

(12) 247567
475

(13) 317649
689

(14) 2706915
3746

(15) 147678
5682

(16) 47269
78581

(17) 73581
47269

(18) 764258 × 417396

(19) 417396 × 764258

(20) 2719064 × 5648736

CASE III.

When Cyphers are intermixed with the Figures in the Multiplier.

RULE.

Omit them, and place the firſt Figure of each particular Product under its reſpective Multiplier.

EXAMPLES.

(21) 10746047 × 40500108

(22) 804700625 × 207008009

CASE IV.

When there are Cyphers at the Right-hand of either, or both the Multiplier and Multiplicand.

RULE.

Proceed as before, neglecting the Cyphers until the particular Products are added together, and to that Sum place the Number of Cyphers that are at the End of both Factors, on the Right-hand.

EXAMPLES.

(23) 1460900 × 8700

(24) 2768000 × 24600

If it be required to multiply any Number by 10, 100, 1000, &c. it is only annexing the Cyphers of the Multiplier to the Right-hand of the Multiplicand, and the Work is done.

CASE V.

When the Multiplier is ſuch a Number that any two Figures (in the Table), being multiplied together, will produce it.

RULE.

Multiply the given Number by one of thoſe Figures, and that Product by the other, which will give the deſired Product.

EX-

EXAMPLES.

(25) Multiply 24674 by 16.
(26) Mul. 340764 by 28.
(27) Mul. 142395 by 56.
(28) Mul. 176848 by 81.
(29) Mul. 420746 by 72.
(30) Mul. 17093 by 63.
(31) Mul. 43074 by 144.
(32) Mul. 14068 by 132.

CASE VI.

When the Multiplier is any Number between 10 and 20.

RULE.

Multiply by the Figure in the Units Place, and as you multiply, add to the Product of each ſingle Figure, that of the Multiplicand, which ſtands next on the Right-hand.

EXAMPLES.

(33) 142716 × 11
(34) 14276 × 12
(35) 146094 × 13
(36) 24176 × 14
(37) 36142 × 15
(38) 176424 × 16
(39) 14609 × 17
(40) 18627 × 18
(41) 142768 × 19

3. DIVISION

TEACHETH us to find how often one Number is contained in another, or to divide any Number or Quantity given, into any Parts aſſigned, and ſerves inſtead of many Subtractions. In this Rule there are three Numbers real, and a fourth accidental, viz.

1. The Dividend, or Number to be divided.
2. The Diviſor, or Number by which you divide.
3. The Quotient, or Number that ſhews how often the Diviſor is contained in the Dividend.

4. The

4. The Remainder, which is always leſs than what you divide by.

CASE I.

When the Diviſor is not greater than 12.

RULE.

Firſt ſeek how often the Diviſor is contained in the firſt Figure of the Dividend, or if in caſe the firſt Figure of the Dividend be leſs than the Diviſor, then in the two firſt Figures of the Dividend, and ſet the Quotient Figure down accordingly, and, if any Thing remains, carry it to the next Figure in the Dividend, where it muſt be reckoned as ſo many Tens, that is, if one remains you call it 10; if two, 20; if five, 50; and ſo on, bearing in Mind the Remainder of each Figure, and adding it to the next, until you have made Uſe of all the Figures in the Dividend. This is called ſhort Diviſion.

PROOF.

Multiply the Quotient by the Diviſor, and as you multiply, add the Remainder (if any), or add the whole Remainder to the Product at laſt, and if it comes the ſame as the Dividend, the Work is right.

EXAMPLES.

(1) 2)1742636.

(2) 3)2764064.

(3) 4)2160742.

(4) 5)1076426.

(5) 6)71420954.

(6) 7)4674263.

(7) 8)2768096.

(8) 9)6768094.

(9) 11)2762764.

(10) 12)276484.

CASE II.

When the Diviſor conſiſts of many Places or Figures.

RULE.

RULE.

1. If the Divisor be a less Number than so many Figures taken in the Dividend, see how often the first Figure of the Divisor is contained in the first Figure of the Dividend, and the Figure which expresses it is the first of the Quotient, by which multiply the Divisor, and place the Product under the said Figures of the Dividend, and draw a Line underneath it; subtract it therefrom, and to the Remainder annex the following Figure of the Dividend, then proceeding as before.

2. But if it happen that the Divisor be a greater Number than so many Figures of the Dividend, then you must take a Number of Places in the Dividend greater by one, and see how often the first Figure in the Divisor is contained in the two first of the Dividend, Allowance being made for what you carry from the Figure on the Right.

3. If in any Case the Remainder be so small, that when the Figure of the Dividend, joined with it, make a Sum less than the Divisor, then a Cypher is to be placed in the Quotient, and another Figure brought down, and then proceed as before; this is called Long Division.

EXAMPLES.

(11) 25)736473575((16) 7489)1204530760(
(12) 84)35730972((17) 42163)112737328(
(13) 648)272357640((18) 61745)392628787(
(14) 759)30891829676((19) 684573)3233238699(
(15) 3065)63463902247((20) 476085)98839054780(
(21) 4728395)27750950255(

CASE III.

When the Divisor has Cyphers on the Right-Hand.

RULE.

Strike off so many of the last Figures in the Dividend, and divide by those Figures of the Divisor that are left when the Cyphers are omitted. But when the Division is ended, those Cyphers so omitted in the Divisor, and the Figures cut off in the Dividend, are both to be restored to their own Places.

EXAMPLES.

(22) 2800)11928248((23) 172000)247004674(

When the Dividend has the ſame Number of 0's on the Right-hand as the Diviſor, ſtrike them off from each, and the Remainder will be ſo many of what you divide by, without annexing the 0's that were ſtruck off.

(24) 473000)351858000((25) 6970000)599430000(

CASE IV.

When the Diviſor is ſuch a Number, that any two Figures (in the Multiplication Table) being multiplied together, will produce the ſaid Diviſor.

RULE.

Divide the given Number by one of thoſe Figures, and that Quotient again by the other, which will give the Quotient required.

Note.—Obſerve, That if there be a Remainder in the laſt Diviſion, it will be ſo many Times the firſt Diviſor, which added to the firſt Remainder (if any) will give the true one.

EXAMPLES.

(26) (27) (28) (29) Divide { 1206816, 42768, 74682, 14276 } by { 16, 48, 72, 144 }

(30) (31) (32) (33) Divide { 247684, 14652, 417681, 307684 } by { 28, 64, 81, 32 }

When the Learner is pretty well verſed in Diviſion, he may ſubtract each Figure of the Product, as he produces it, and ſo only write the Remainder, which will ſhorten the Work, and be much the beſt Way, (when the Diviſor is ſmall.)

EXAMPLES.

(34) 17)690489((36) 467)2148686(

(35) 86)5343698((37) 6074)24939844(

TABLES of ENGLISH COINS.

Marked			
q.	4 Farthings	are one	Penny.
d.	12 Pence		Shilling.
s.	20 Shillings		Pound, £.

$\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ is wrote for q. 1, 2, 3

PENCE

PENCE TABLE.

d.		*s.*	*d.*	*d.*		*s.*
20		1	8	24		2
30		2	6	36		3
40		3	4	48		4
50		4	2	60		5
60		5	0	72		6
70	are	5	10	84	are	7
80		6	8	96		8
90		7	6	108		9
100		8	4	120		10
110		9	2	132		11
120		10	0	144		12

The WEIGHTS and VALUE of ſuch GOLD and SILVER COINS as are moſt commonly uſed in ENGLAND.

	Weight. *dwts.gr.mites.*	Value. *l. s. d.*
A Guinea —	5 9 9 — —	1 1 0
Half ditto —	2 16 14 — —	0 10 6
A Quarter ditto -	1 8 7 — —	0 5 3

SILVER.

A Crown —	19 8 10½ — —	0 5 0
Half ditto —	9 16 5⅗ — —	0 2 6
A Shilling —	3 20 18 — —	0 1 0
A Sixpence —	1 22 9 — —	0 0 6

Note.—20 Mites make one Grain.

N. B. Beſides the above Coins, we have had Portugal Money in uſe here, the Value and Weight of which are as follows:

	l.	*s.*	*d.*		*dwts.gr.*
A Piece of —	3	12	0	ſhould weigh	18 16
Ditto of —	1	16	0	— — —	9 6
Ditto of —	0	18	0	— — —	4 15
Ditto of —	0	9	0	— — —	2 7⅛
A Moidore —	1	7	0	— — —	6 18
Half ditto -	0	13	6	— — —	3 9
Quarter ditto	0	6	9	— — —	1 16½

A Pound Weight Avoirdupoiſe of Copper, is coined into twenty-three Pence; conſequently a Halfpenny is one third of an Ounce nearly, and a Farthing one ſixth.

Note.

s.	*d.*		
6	8	are one	Noble.
10	0		Angel.
13	4		Mark.

6. REDUCTION

TEACHETH to reduce all great Names into ſmall, by multiplying the given Number with ſo many of the next lower Name, as to make one of the higher, ſtill keeping them equivalent in Value, and is called Reduction deſcending; on the contrary, all ſmall Names are brought into great, by dividing the given Number by ſo many of the leſſer Name as make one of the next greater; this is the Converſe of the laſt, and is termed Reduction aſcending.

EXAMPLES in MONEY.

1. In 27*l.* how many Shillings and Pence?
2. Reduce 6480*d.* to Shillings and Pounds.
3. How many Shillings, Pence, and Farthings, are there in 40*l.* 10*s.*?
4. In 38880 Qrs. how many Pounds?
5. Reduce 104*l.* 17*s.* 6¾*d.* to Farthings.
6. How many Pounds in 100683 Qrs.?
7. In 21 Guineas, how many Shillings, Pence, and Farthings?
8. Reduce 21168 Farthings to Guineas.
9. In 42 Moidores how many Farthings?
10. How many Moidores in 54432 Farthings?

WEIGHTS and MEASURES.

TROY WEIGHT.

Marked			
gr.	24 Grains	are one	Penny Weight.
dwts.	20 Penny Weights		Ounce.
oz.	12 Ounces		Pound. lb.

By

By Troy Weight is weighed Gold, Silver, Jewels, Amber, Bread, Corn, and all Liquors, and from this Weight all Meaſures from wet and dry Commodities are taken.

N. B. 14 *oz.* 11 *dwts.* 15½ *grs.* Troy, is equal to 1 Pound Avoirdupoiſe.

EXAMPLES.

1. In 24 *lb.* of Silver, how many Ounces, Penny Weights, and Grains?
2. Reduce 138240 *grs.* to *dwts.* *oz.* and *lb.*
3. In an Ingot of Silver weighing 12 *lb.* 10 *oz.* 22 *grs.* how many Grains?
4. Reduce 73942 *grs.* to Pounds.

APOTHECARIES WEIGHTS.

Marked			
grs.	20 Grains	are one	Scruple.
℈	3 Scruples		Dram.
ʒ	8 Drams		Ounce.
℥	12 Ounces		Pound, ℔.

Apothecaries, in making up their Medicines, uſe this Weight, but they buy and ſell their Drugs by the Avoirdupoiſe Weight.

EXAMPLES.

5. In 14 *lb.* how many Ounces, Drams, Scruples, and Grains?
6. Reduce 80640 *grs.* to ℈, ʒ, ℥, and ℔.
7. How many Grains, 4 ℔, 11 ℥, 2 ℈, 17 grs.?
8. In 28377 *grs.* how many Pounds?

AVOIRDUPOISE WEIGHT.

Marked			
dr.	16 Drams	are one	Ounce.
oz.	16 Ounces		Pound.
lb.	28 Pounds		Quart. of Cwt.
qr.	4 Quarters or 112 lb.		Hundred.
cwt.	20 Hundred		Ton.

By Avoirdupoiſe Weight is weighed all manner of Things that have Waſte, as all Phyſical Drugs and Grocery, Roſin, Wax, Pitch, Tar, Tallow, Soap, Hemp, Flax, Hay, Wool, &c. all baſe Metal and Minerals, as Iron, Steel, Lead, Tin, Copper, Allum, Copperas, &c. Alſo Bread, Butter, Cheeſe, Salt, Butcher's Meat, &c.

The Denominations in ſome of which are as follow, viz.

8 Pounds	are one	Stone of Butcher's Meat.
14 Pounds		Stone of Horſeman's Weight.
19½ Hundreds		Fodder of Lead.

WOOL WEIGHT.

7 Pounds	are one	Clove.	6½ Todds	are one	Wey.
2 Cloves		Stone.	2 Weys		Sack.
2 Stones		Todd.	12 Sacks		Laſt.

HAY.

56 Pounds of old Hay, or 60 Pounds of new ditto	are 1 Truſs.
36 Truſſes	are 1 Load.

BREAD.

	Weight. lb. oz. dr.
Peck Loaf	17 6 1
Half ditto	8 11 0½
Quartern do.	4 5 8¼

Note.—There are ſome Sorts of Silk which are weighed by a great Pound of 24 oz.

EXAMPLES.

9. In 1 Ton, or 20 *Cwt.* how many Quarters, Pounds, Ounces, and Drams?
10. Reduce 573440 *drs.* to Hundreds, &c.
11. Reduce 27 *lb.* 12 *oz.* 11 *drs.* to Drams.
12. How many Pounds in 7115 *drs.*?
13. In 12 Tons, 10 *cwt.* 14 *lb.* 11 *oz.* 15 *drs.* how many *drs.*?
14. How many Tons are there in 7171775 *drs.*?

CLOTH MEASURE.

			Marked.
4 Nails	are one	Quarter of a Yard	na. qrs.
3 Quarters		Ell Flemiſh.	Ell Fl.
4 Quarters		Yard	Yd.
5 Quarters		Ell Engliſh	Ell Eng.
6 Quarters		Ell French.	Ell Fr.

Scotch

Scotch and Irish Linens are bought and sold by the Yard; but Dutch Linens are bought by the Ell Flemish, and sold by the Ell English.

EXAMPLES.

15. In a Piece of Cloth containing 24 Yards, how many Quarters and Nails?
16. Reduce 384 Nails to Yards.
17. How many Nails are there in 72 *Ells Eng.* 4 *qrs.* 2 *na.*?
18. Reduce 1458 Nails to Ells English.
19. In 121 Ells Flemish, how many Nails?
20. Reduce 1452 Nails to Ells Flemish.
21. How many Nails in 42 *Ells Fr.* 5 *qrs.*?
22. Reduce 1028 Nails to Ells French.

LONG MEASURE.

Marked				
b. c.	3	Barley Corns	are one	Inch.
in.	12	Inches		Foot.
f.	3	Feet or 36 Inches		Yard.
yd.	2	Yards or 6 Feet		Fathom.
	$5\frac{1}{2}$	Yards or 11 half-yds.		Pole, Rod or Perch.
p.	40	Poles or 220 Yards		Furlong.
fur.	8	Furlongs or 1760 yds.		Mile.
m.	3	Miles		League.
lea.	$23\frac{1}{2}$	Leagues or $69\frac{1}{2}$ Miles		Degree, Deg.

360 Degrees are the Circumference of the Globe.
5 Feet is a Geometrical Pace.
$16\frac{1}{2}$ Feet is a Pole.

ALSO,

4 Inches	are one	Hand or Hand's Breadth.
3 Hands Breadth		Foot.
$1\frac{1}{2}$ Foot		Cubit.
2 Cubits		Yard.

By this Measure, Distances of Places, or any Thing else, that has Length only, are measured.

EXAMPLES.

23. In 176 *m.* 30 *p.* how many Poles?
24. Reduce 63350 Poles to Miles.

25. How

25. How many Yards, Feet and Inches, are there in 200 Miles?
26. In 12672000 Inches, how many Miles?
27. Reduce 12 Leag. 1 M. 6 Fur. 29 P. 4 Yds. to Barley Corns.
28. In 7193178 b. c. how many Leagues, &c.

LAND MEASURE.

Marked			
	5½ Yards		Perch, Rood, or Pole.
p.	40 Poles		Rood.
r.	4 Roods	are one	Acre.
a.	30 Acres		Yard of Land.
	100 Acres		Hide of Land.

The best Way of measuring Land, is by a Chain of 4 Poles, or 66 Feet long, which is divided into 100 equal Parts, called Links.

In. b. c.		
7 276		Link.
25 Links		Pole.
4 Poles or 100 Links or 22 Yards	are one	Chain.
10 Chains		Furlong.

EXAMPLES.

29. In 42 Acres, how many Roods and Poles?
30. Reduce 6720 Poles to Acres.
31. In 12 *A.* 3 *R.* 29 *P.* how many Poles?
32. How many Acres in 2069 Perches?

WINE MEASURE.

Marked				
pts.	2 Pints			Quart.
qts.	4 Quarts or 8 Pints			Gallon.
gall.	10 Gallons			Anchor of Br. or R.
	18 Gallons			Runlet.
	31½ Gallons		are one	Barrel.
	42 Gallons			Tierce.
tier.	2 Tierce, or 84 Gallons			Puncheon, punch.
	63 Gallons			Hogshead.
h.	2 Hogsheads or 126 Gal.			Pipe or Butt.
p.	2 Pipes or 252 Gal.			Tun.

Note.

Note.—A Tun of Wine is 18 Cwt. Avoirdupoiſe.

A Gallon is 231 ſolid Inches.

By Wine Meaſure, all Spirits, Mead, Perry, Cyder, Vinegar, Oil, and Honey, &c. are meaſured; as alſo Milk, not by Law, but Cuſtom only.

EXAMPLES.

33. In 4 Anchors of Brandy, how many Gallons and Quarts?
34. In 160 Quarts, how many Anchors?
35. Reduce 4 Hhds. of Wine to Gallons and Pints.
36. How many Hogſheads of Wine are in 2016 Pints?
37. Reduce 42 Tierces and 24 Gallons to Pints.
38. How many Tierces in 14304 Pints?
39. In 4 Tuns, 1 p. 1 hhd. 42 gal. 6 pts. how many Pints?
40. Reduce 9918 Pints to Tuns, &c.

WINCHESTER MEASURE.

Called alſo Ale and Beer Meaſure.

Marked			
pts.	2 Pints		Quart.
qts.	4 Quarts or 8 Pints	are one	Gallon.
gal.	8 Gallons Ale, or 9 Gallons Beer		Firkin.
fir.	2 Firkins	Gal.	Kilderkin.
kil.	2 Kilderkins, or 4 Firkins	or { 32 Ale / 36 Beer }	are 1 Barrel.
bar.	1½ Barrel, or 3 Kilderkins	or { 48 Ale / 54 Beer }	are 1 Hogſhead.
hhds.	2 Hogſheads or 3 Bar. or 108 Gal.	are one	Butt.
	2 Butts or 216 Gallons		Tun.

Note.—8½ Gallons is a Firkin of Beer or Ale, in all Parts of England, except London.

A Gallon of Ale or Beer, is 282 ſolid Inches.

A Firkin of Soap or Herrings is the ſame with that of Ale.

EXAMPLES.

41. In 12 Barrels of Ale, how many Gallons and Quarts?
42. Reduce 1536 Quarts of Ale to Barrels.

43. In

43. In 42 Barrels of Beer, how many Pints?
44. Reduce 12096 Pints of Beer to Barrels.
45. In 6 hhds. 27 gal. 6 pts. of Ale, how many pts.?
46. How many hhds. of Ale in 2526 pts.?
47. How many gal. and pts. in 14 hhds. 47 gal. of Beer?
48. Reduce 6424 Pints of Beer to Hogſheads.
49. Reduce 6 Tuns, 1 Butt, 42 Gal. of Beer to Quarts.
50. How many Tuns, &c. in 5784 Quarts of Beer?

DRY MEASURE.

Marked			
pts.	2 Pints		Quart.
qts.	4 Quarts or 8 Pints		Gallon.
gal.	2 Gallons		Peck.
pks.	4 Pecks or 8 Gallons	are one	Buſhel.
bu.	4 Buſhels		Comb.
c.	2 Combs or 8 Buſhels		Quarter.
qrs.	5 Quarters		Wey.
	2 Weys or 10 Quarters		Laſt.

ALSO,

4 Quarters or 32 bu. / 2 Buſhels } are one { Chaldron / Strike } of Corn.

A Load of Corn is 5 Buſhels.
A Cart Load of ditto is 40 Buſhels.
2 Quarts are one Pottle, both in Liquid and Dry Meaſure.
A Gallon contains 268¾ ſolid Inches.

In meaſuring Sea Coal,
5 Pecks is one Buſhel, Water Meaſure.

3 Buſhels	are one	Sack.
9 Buſhels		Vatt.
36 Buſhels, or 12 Sacks		Chaldron.
21 Chaldrons		Score.

By Dry Meaſure, Corn, Salt, Coals, and all other Dry Goods are meaſured.

The ſtandard Buſhel is 18½ Inches wide, and 8 Inches deep.

EXAMPLES.

51. In 24 Quarters of Corn, how many Buſhels, Pecks, Gallons, and Quarts?

52. How

52. How many Quarters of Corn in 6144 qts.?
53. Reduce 36 chs. 26 bu. of Coals to Pecks.
54. How many Chaldrons of Coals in 5288 Pecks?
55. In 64 Lasts of Corn, how many Weys, bu. and Pecks?
56. How many Lasts in 20480 Pecks?

TIME.

Time of itself is nothing, but from Thought
Receives its Rise, by labouring Fancy wrought;
From things consider'd whilst we think on some,
As present, some as past, or yet to come:
No Thought can think on Time, that's still confess'd,
But thinks on Things, in Motion or at Rest.

Marked			
'''	60 Thirds	are one	Second.
sec.	60 Seconds		Minute.
m.	60 Minutes		Hour.
h.	24 Hours		Day.
d.	7 Days		Week.
w.	4 Weeks, or 28 Days		Month.
mo.	52 Weeks, 1 Day, 6 Hours, or 13 Months, 1 Day, 6 Hours, or 365 Days, 6 Hours		Year Julian.

365 Days, 5 Hours, 48 Minutes, 57 Seconds, 39 Thirds, are a Solar Year.

The Year is also divided in 12 unequal Calendar Months, called,

January, February, March, April, May, June, July, August, September, October, November, December.

And to know how many days are in each Month, observe (to get by heart) the following Lines:

Thirty Days hath September,
April, June, *and* November;
February *hath twenty-eight alone,*
And all the rest hath thirty-one;
Except Leap-year, and then's the Time,
February's *Days are twenty-nine.*

EXAMPLES.

EXAMPLES.

57. How many Hours, Minutes, and Seconds, are there in a Week, or 7 Days?
58. In 604800 Seconds, how many Days?
59. Reduce 6 mo. 4 d. to ſec.
60. In 14860800 ſec. how many Months?
61. How many Seconds are there in a Julian Year, or in 365 Days, 6 Hours?
62. In 31557600 ſec. how many Days?
63. How many Thirds are there in a Solar Year, or in 365 Days, 5 Hours, 48 Minutes, 57 Seconds, and 39 Thirds?
64. Reduce 1893416259 Thirds to Days.

SQUARE or SUPERFICIAL MEASURE.

144	Square Inches	are one	Square Foot.
9	Feet		Yard.
30¼	Yards		Pole.
40	Poles		Rood.
4	Roods		Acre.
640	Acres or		Mile.
4840	Yards		

272¼ Feet is one Rod of Brick Work.
100 Square Feet is one Square of Flooring.

By this Meaſure are meaſured all Things in which Length and Breadth is only conſidered.

EXAMPLES.

65. In 42 Square Yards, how many Square Inches?
66. How many Square Yards in 54432 Square Inches?
67. Reduce 3 ſq. 42 Feet, 64 in. of Flooring to Inches.
68. How many Squares are there in 44312 ſq. Inches?

CUBIC or SOLID MEASURE.

1728	Solid Inches	are one	Solid Foot.
27	Feet		Yard.
40	Feet of round Timber, or		Ton or Load.
50	Feet of hewn Timber		

A Solid Yard of Earth is called a Load.

108 Solid

108 Solid Feet (i. e.) 12 Feet long, 3 Feet broad, and 3 Feet deep, or commonly 14 Feet long, 3 Feet 1 Inch broad, and 3 Feet 1 Inch deep, is a Stack of Wood; 128 ſolid Feet, (i. e.) 8 Feet long, 4 Feet broad, and 4 deep, is a Cord of Wood.

By this Meaſure are meaſured all Things, in which are conſidered Length, Breadth, and Depth or Thickneſs.

EXAMPLES.

69. In 27 ſolid Yards, how many ſolid Inches?
70. Reduce 1259712 ſolid Inches, to ſolid Yards?
71. How many ſolid Inches are there in 4 Tons 24 Feet of hewn Timber?
72. In 387072 ſolid Inches, how many Tons of hewn Timber?

Of ſome particular WARES or GOODS.

12	are one	Dozen.
12 Dozen		Groſs.
12 Groſs		Great Groſs.
20		Score.
5 Score		Hundred.
6 Score, or 120		Great Hundred.
1000		Thouſand.

END OF BOOK I.

THE

TUTOR's GUIDE.

BOOK II.

EXERCISE in NUMERATION.

IN Figures expreſs the following Number, viz.

1. One Million and a half in South Sea Bonds.

2. Threeſcore and twelve Thouſand thirteen Hundred Weight of Lead.

3. Fifteen Thouſand and fourſcore Million of Stivers.

4. One Hundred and twenty Thouſand two Hundred and ſixty Millions ſeventy Thouſand ſeven Hundred and ſeven Rials of Plate.

5. Three Million and thirty-three Thouſand and thirty Pieces of Eight.

6. Four Hundred Thouſand and forty Hundred Pounds, thirty-four Shillings, and fourteen Pence five Farthings.

ADDITION.

EXAMPLES of INTEGERS.

1. Add the following Numbers, viz. 140724, 296, 42, 6740, 64167, 20, 2687, and 2684 together.

2. Add 27460, 176, 2900, 274, 1004, 64, 596, 41, and 6104 together.

3. Add 867, 317, 69, 1720, 276842, 49, 426074, and 60 together.

7. COM-

7. COMPOUND ADDITION

TEACHETH to add ſundry Sums or Numbers together, having divers Denominations, as in Money, Weights, Meaſures, &c.

RULE.

1. Place the Numbers of a like Denomination under each other, viz. Pounds under Pounds, Shillings under Shillings, Pence under Pence, Farthings under Farthings, &c.

2. Begin to add, at the loweſt Denomination firſt, as in Integers, then divide that Sum by as many of the ſame Denomination as make one of the next greater, ſetting down the Remainder under the Row added, and carry the Quotient to the next ſuperior or greater Denomination, whoſe Sum you muſt alſo find; proceed in this Manner to the laſt (or greateſt Denomination), which add as Integers.

EXAMPLES of MONEY.

	l.	*s.*	*d.*
(1)	4	17	11¼
	2	6	4
	1	19	10¾
	3	11	6½
	8	17	9
	1	4	0
	6	0	11¾
	5	12	6
	2	8	11¼

	l.	*s.*	*d.*
(2)	14	11	6
	27	16	11½
	41	17	7
	56	6	4¼
	17	11	11½
	47	6	4
	0	10	6
	4	0	0
	17	17	6¾

	l.	*s.*	*d.*
(3)	127	11	10½
	41	17	6
	100	0	0
	52	10	11¾
	116	12	6
	24	19	11½
	6	6	0
	0	10	6
	2	2	0

(4) Add 270*l.* 16*s.* 6½*d.* 60*l.* 10¼*d.* 60*l.* 10*s.* ¾*d.* 96*l.* 6*s.* 10*d.* 176*l.* 6*s.* 6½*d.* 2*l.* 2*s.* 16*l.* 17*s.* 6½*d.* and 100*l.* into one Sum.

(5) Add 260*l.* 17*s.* 67*l.* 10*s.* 10¾*d.* 170*l.* 10*s.* ½*d.* 100*l.* 10*s.* 6¼*d.* 4*l.* 16*s.* 6½*d.* 19*s.* ¾*d.* 37*l.* 11*s.* 11½*d.* 600*l.* 10*s.* and 220*l.* 6½*d.* into one Sum.

(6) Add 276*l.* 17*s.* 16*l.* 10¼*d.* 269*l.* 11*s.* 11½*d.* 107*l.* 19*s.* 10*l.* 6*d.* 14*s.* 11*d.* 367*l.* 17*s.* 6¾*d.* 12*s.* 4½*d.* 20*l.* 10*s.* 6*d.* and 1000*l.* into one Sum.

Of WEIGHTS and MEASURE.

(1)

oz.	*dwts.*	*grs.*
27	11	20
17	14	21
46	17	11
27	14	6
4	9	17
17	19	22
27	17	16

(2)

lb.	*oz.*	*dwts.*	*grs.*
27	10	17	11
11	11	19	6
4	6	14	17
27	10	17	23
17	7	11	17
6	4	0	16
17	11	18	15

(3)

℥	ʒ	℈	*grs.*
11	2	1	17
7	4	2	14
4	1	1	19
2	5	2	11
10	1	2	16
14	7	1	13
11	4	2	11

(4)

℔	℥	ʒ	℈	*grs.*
14	11	4	2	11
11	2	1	1	17
4	10	2	2	16
17	4	7	1	4
5	11	0	2	11
17	10	1	1	14
14	6	4	2	15

(5)

Tons.	*C.*	*qr.*	*lb.*
14	17	2	14
417	11	1	21
24	6	3	27
219	14	1	14
36	17	2	26
11	14	1	14
6	11	2	19

(6)

lb.	*oz.*	*drs.*
14	11	14
17	14	11
5	6	12
21	4	15
86	13	11
14	7	10
6	11	6
4	4	12

(7)

yds.	*qrs.*	*na.*
14	2	3
276	1	0
37	3	2
4	1	1
110	0	0
17	3	2
13	2	3
106	1	2

(8)

Eng. Ells.	*qrs.*	*na.*
12	4	2
27	0	0
42	2	3
176	3	2
94	1	3
62	2	1
142	1	2
41	2	3

(9)

Fl. Ells.	*qrs.*	*na.*
17	2	1
42	1	2
146	2	1
64	1	3
72	2	1
87	1	2
100	0	0
43	2	3

(10)

lea.	*m.*	*fur.*	*p.*
12	1	7	14
27	1	4	27
141	2	6	86
84	0	7	39
100	1	4	11
36	2	5	13
4	0	0	24
120	2	6	6

(11)

yds.	*f.*	*in.*	*b.c.*
141	2	11	2
27	1	4	1
214	2	10	2
76	0	11	0
217	2	4	2
96	1	11	1
140	2	0	0
60	0	10	1

	A.	*r.*	*p.*
(12)	210	2	27
	74	3	14
	142	1	37
	47	2	14
	149	0	27
	34	3	36
	8	1	11

	tuns.p.hds.ga.qts.				
(13)	12	1	1	14	2
	14	1	1	27	3
	10	1	0	61	1
	6	1	1	42	2
	2	0	0	26	3
	13	1	1	4	2
	6	0	0	36	3

	punch.gal.qt.pt.			
(14)	14	14	2	1
	7	32	3	1
	24	51	2	1
	14	14	1	1
	49	36	3	1
	37	17	1	1
	8	62	3	1

	tier.	*gal.*	*pts.*
(15)	12	24	7
	41	41	4
	3	26	2
	0	14	5
	27	39	6
	19	14	4
	21	34	3

	anch.	*gal.*	*pts.*
(16)	10	7	4
	14	9	7
	27	4	2
	4	6	0
	11	5	3
	2	3	5
	17	2	6

	A.hhds.gal.qts.		
(17)	14	12	2
	6	41	3
	17	27	1
	8	34	2
	47	40	3
	4	27	1
	18	11	0

	B.hhds.gal.pts.		
(18)	24	51	7
	14	17	4
	6	8	6
	14	12	0
	9	47	4
	34	36	5
	17	11	2
	4	29	7

	A.bar.kil.fir.ga.pt.				
(19)	14	1	1	4	7
	27	1	0	7	4
	19	1	1	6	5
	6	0	1	5	3
	31	1	0	3	2
	6	0	1	1	6
	10	1	1	4	3
	6	1	0	6	0

	B.fir.gal.qts.pts.			
(20)	14	8	2	1
	9	7	1	0
	10	4	3	1
	6	6	2	1
	27	5	1	0
	8	2	3	1
	41	1	0	1
	6	3	1	1

	qrs.bu.p.gal.			
(21)	14	7	2	0
	27	4	3	1
	142	6	1	1
	19	4	2	0
	4	6	3	1
	227	4	1	0
	41	1	2	1

	cha.bu.p.		
(22)	12	27	2
	21	0	0
	6	31	3
	41	27	1
	36	19	2
	7	24	3
	12	12	2

	la.w.qrs.bu.p.				
(23)	11	1	4	7	3
	14	1	2	4	1
	7	1	3	4	2
	10	0	2	6	1
	6	1	1	4	2
	17	1	2	5	0
	8	1	4	0	3

	mo.	*w.*	*d.*	*h.*
(24)	11	2	4	21
	24	3	6	14
	12	1	0	23
	31	2	5	0
	14	1	1	11
	6	3	6	17
	8	2	1	20

	d.	*h.*	*m.*	*sec.*
(25)	14	21	14	42
	5	17	27	56
	170	10	14	27
	64	17	56	19
	210	23	0	46
	42	4	6	8
	4	19	59	42

APPLICATION.

1. HOW many Days are there from June 1, to Jan. 27, following?
2. Suppoſe a Man to be born in the Year of our Lord 1772, in what Year will he be 60 Years of Age?
3. A Gentleman left his eldeſt Daughter one Thouſand Pounds more than the youngeſt, whoſe Fortune was eleven Thouſand eleven Hundred and eleven; what was the eldeſt Daughter's Fortune, and what did the Father leave them?
4. In the Biſſextile, or Leap Year, how many Days in each Month, and what is their Sum?
5. A. owes ſuch a Sum of Money, that if he paid ſeventeen Pounds ſeventeen Shillings and Sixpence, the Remainder to pay will be eighty-two Pounds two Shillings and Sixpence; required the Sum owed?
6. A Privateer took a Prize, the private Men's Share came to 474*l.* 17*s.* 11½*d.* and the Officers received as much, beſides 467*l.* unknown to the private Men; how much did the Officers receive?
7. A Nobleman, going out of Town, is informed by his Steward that his Corn Chandler's Bill comes to 123*l.* 19*s.* His Brewer's to 41*l.* 10*s.* His Butcher's 212*l.* 6*d.* To his Lordſhip's Baker is owing 24*l.* To his Tallow-Chandler 13*l.* 8*s.* To his Taylor 137*l.* 9*s.* 9*d.* To his Draper 74*l.* 13*s.* 6*d.* His Coach-Maker's Demand was 214*l.* 16*s.* 6*d.* His Wine-Merchant's 68*l.* 13*s.* His Confectioner's 16*l.* 2*s.* His Rent 82 Guineas, and his Servants Wages, for Half a Year, came to 46*l.* 1*s.* What Money muſt he ſend to his Banker for, in Caſe

Caſe he would carry with him 50*l.* to defray his Expence on the Road?

8. A Corn-factor buys ſeventy Quarters of Oats, for 46*l.* 7*s.* 6d. thirty-eight Quarters of Beans, for 100*l.* twelve Quarters of Peaſe, which coſt 16*l.* 16*s.* eighty-eight Quarters of Barley, for 73*l.* 8*d.* ſixteen do. of Wheat, for 56*l.* 9*s.* 10*d.* and ſix Quarters of Rye, for 4*l.* 4*s.* 6*d.* The Water carriage of all comes to 13*l.* 2*s.* 7*d.* his riding Charges to 1*l.* 13*s.* and if he clears eighteen Guineas by the Bargain, what do his Bills of Parcels amount to?

9. A Collector of Caſh has been out with Bills, and gives an Account that A. paid him 13*l.* and Half a Crown; B. 2*l.* 13*s.* C. 14*s.* and a Groat. D. 1*l.* 9*s.* 8½*d.* E. 11*l.* 6½*d.* F. 17*s.* and a Teſter. G. 12*s.* 6*d.* H. a Pound, and Half a Guinea. I. a Moidore, and 13*s.* K. two broad Pieces of 29*s.* each, a Jacobus of 25*s.* and a Shilling. L. nine Pounds and a Mark. M. 12*l.* 12*s.* N. a Bank Note of 15*l.* and O. three Crown Pieces and an Angel: what Caſh had he in Charge?

10. A. of Amſterdam is Debtor to B. of Briſtol for Mercery Wares, as per Factor, 418*l.* 2*s.* 6*d.* for forty Cwt. of Cheſhire Cheeſe, 52*l.* 18*s.* for Engliſh Broad-cloath, fifteen Pieces, 317*l.* 12*s.* 10*d.* for 19 Fodder of Lead, 320*l.* for 12 Tons of Bar-iron, 173*l.* 3*d.* for eight Tons of Copper, 1110*l.* 10*s.* 1*d.* for his Acceptance of a Bill drawn, 88*l.* 14*s.* for another paid for Honour, 50*l.* ten Dozen of Morocco Skins, 28*l.* 15*s.* 4*d.* paid Convoys, Inſurance, and Port Charges, 43*l.* Warehouſe Room, Poſtage, Sledage, Boatage, and incidental Charges, 5*l.* 5*s.* The Factorage of all came to 112*l.* 6*s.* For what Sum muſt B. draw to clear the Account?

11. In a Gentleman's Service of Plate there are fourteen Diſhes, weighing 198 oz. 6 dwts. Plates thirty-ſix, weighing 421 oz. 11 dwts. four Dozen of Spoons, weighing 104 ounces, 6 dwts. ſix Salts chaſed, weighing 32 oz. Knives and Forks, weighing 83 oz. 9 dwts. four Preſenters weighing 113 oz. 4 dwts. in Mugs, Tumblers, Beakers, and other odd Pieces, wt. 264 oz. 18 dwts. A Silver Tea-Kettle and Lamp, weighing 126 oz. 9 dwts. and the Reſt of that Equipage 98 oz. 2 dwts What Quantity of Plate had the Butler under his Care?

12. A Mer-

12. A Merchant buys four Bags of Canterbury Hops, No. 1. of which weighed 2 cwt. 2 qr. 10 lb. No. 2. 2 cwt. 1 qr. 16 lb. No. 3. 2 cwt. 24 lb. No. 4. 1 qr. 16 lb. beſides a couple of Pockets of ditto, that weighed 58½ lb. each. How many Hundred Weight has he to pay Carriage for, on bringing them to Town?

13. A Gentleman at A. deſired to know how far it was to E. and had the following Anſwer, viz. from hence to B. is 39 m. 6 fur. thence to C. is 46 m. 24 p. then to D. 60 m. 4 fur. 39 p. and thence to E. 37 m. 6 fur. What is the Diſtance from A. to E.?

14. A Father was 28 Years old, (reckoning 13 Months to a Year, and 28 Days to 1 Month) when his eldeſt Child was born, betwixt the eldeſt and ſecond were 2 Years, 10 Months, and 16 Days; betwixt the ſecond and third were 1 Year, 11 Months; betwixt the third and fourth were 3 Years, 7 Months, 12 Days, when the fourth is 16 Years, 9 Months, 27 Days. How old is the Father?

QUESTIONS *for Exerciſe at leiſure Hours.*

15. How much is A. (born 16 Years ago) older than B. who will come into the World 14 Years hence?

16. A Perſon was 17 Years of Age 29 Years ſince, and he will be drowned 33 Years hence: Pray in what Year of his Age will this happen?

17. A Perſon ſaid he had 20 Children, and that it happened there was a Year and a Half between each of their Ages, his eldeſt was born when he was 24 Years old, and the Age of the youngeſt is now twenty-one; what was the Father's Age?

18. A Sheep-fold was robbed three Nights ſucceſſively, the firſt Night half the Sheep were ſtolen and half a Sheep more; the ſecond Night half the Remainder were loſt, and half a Sheep more; the laſt Night they took half what were left, and half a Sheep more; by which Time they were reduced to twenty; how many were there at firſt?

19. Find how many Years it was from the Creation of Adam to the univerſal Deluge in the Days of Noah, called Noah's Flood; by the 5th Chapter, and 6th Verſe of the 7th Chapter of Geneſis.

SUBTRAC-

SUBTRACTION.

EXAMPLES of INTEGERS.

(1) From 476004 take 120706. (2) From 276000 take 106019. (3) From 40106 take 27109.

8. COMPOUND SUBTRACTION

Teacheth to find the Difference between any two Sums of divers Denominations, as Money, Weights, Measures, &c.

RULE.

Subtract as in Integers, only when the under Number of any Denomination is greater than that which ſtands over it; borrow ſo many of that Denomination as make one of the next Superior, from which take the under Number, and to the Remainder add the upper Number, which ſum ſet down, remembering to carry or add one to the next higher Denomination, before you ſubtract.

EXAMPLES of MONEY.

		l.	*s.*	*d.*
(1)	From	142	17	11½
	Take	121	4	6¾
	Remains			

		l.	*s.*	*d.*
(2)		210	10	10¼
		176	11	11½

		l.	*s.*	*d.*
(3)	Borrowed	264	0	0
	Paid	176	12	6½
	Rem. unpaid			

		l.	*s.*	*d.*
(4)		153	14	6½
		76	0	0¾

		l.	*s.*	*d.*
(5)	Lent	47	6	0½
	Received	36	16	0¾
	Rem. unpaid			

		l.	*s.*	*d.*
(6)		800	10	11
		196	17	11¾

Borrowed

	£.	s.	d.
Borrowed	476	0	0
Paid at sundry Times.	41	17	6
	127	10	11
	89	18	4
	94	17	10
	16	12	6
Paid in all			
Rem. unp.			

(8)

	£.	s.	d.
Lent	1476	14	6
Rec. at sundry Times.	147	14	11
	376	19	6
	600	17	10
	276	14	6
	47	18	0
Received in all			
Rem. unp.			

Borrowed	214	16	$4\frac{1}{2}$
	176	11	$11\frac{1}{4}$
	647	16	$4\frac{1}{2}$
	84	12	$0\frac{1}{2}$
	317	16	$10\frac{1}{2}$
at sundry Times.	176	15	4
	500	0	0
	147	17	6
	374	13	11
	7	19	6
Bor. in all			
Paid			
Rem. unp.			

(9)

(10)

Paid	142	14	6
	176	17	$11\frac{3}{4}$
	67	19	6
	476	0	0
	147	10	10
at sundry Times.	67	18	8
	100	0	0
	427	18	$11\frac{1}{4}$
	176	6	4
	42	17	6
	17	10	0
Paid in all			

Of WEIGHTS and MEASURES.

(1)

	lb.	*oz.*	*dwts.*	*grs.*
Bought	14	10	12	17
Sold	11	11	14	21
Rem. unf.				

(2)

	oz.	*dwts.*	*grs.*
	16	10	21
	12	17	14

(3)

	℔	℥	ʒ	℈	*grs.*
	17	11	4	0	11
	14	10	6	2	17

(4)

	Tons.	*C.*	*qrs.*	*lb.*
From	14	11	2	17
Take	12	11	2	24
Remains				

(5)

	lb.	*oz.*	*dwts.*
	140	10	14
	137	14	15

(6)

	yds.	*qrs.*	*na.*
	141	2	3
	74	3	2

(7)

	Eng.ells.	*qr.*	*na.*
From	120	4	2
Take	117	4	3
Rem.			

(8)

	Fl.ell.	*qr.*	*na.*
	128	0	0
	69	2	3

(9)

	Lea.	*m.*	*fur.*	*pa.*
	120	1	4	24
	80	2	7	37

(10)

	Yds.	*f.*	*in.*	*b.c.*
From	148	2	10	2
Take	97	2	11	2
Rem.				

(11)

	A.	*r.*	*p.*
	246	0	0
	178	2	24

(12)

	Tons.	*p.*	*hhd.*	*gal.*	*p.*
	12	1	1	41	7
	11	1	0	61	6

(13)

	Punch.gal.qts.pts.			
Bought	14	64	2	1
Sold	10	72	3	1
Rem. unf.				

(14)

	Tier.	*gal.*	*pts.*
	16	40	4
	12	41	7

(15)

	Anch.gal.pts.		
	24	4	4
	17	7	7

(16)

	A.hhd.gal.qts.		
From	24	41	2
Take	17	47	3
Rem.			

(17)

	B.hhd.gal.pts.		
	12	46	4
	10	51	7

(18)

	B.fir.gal.pts.		
	14	4	4
	10	8	6

(19)

	A.ba.	*fir.*	*gal.qts.*	*pts.*	
From	42	2	4	2	1
Take	14	3	7	2	1
Rem.					

(20)

	Qu.	*bu.*	*p.*
	12	4	2
	6	7	3

(21)

	Cha.	*bu.*	*p.*
	21	24	0
	14	34	2

(22)

	La.	*w.*	*q.*	*b.*	*p.*
From	12	1	4	4	2
Take	8	0	4	7	3
Rem.					

(23)

	Mo.	*w.*	*d.*	*h.*
	14	2	4	21
	11	2	6	22

(24)

	D.	*h.*	*m.*	*sec.*
	264	14	24	41
	107	21	41	56

APPLI-

APPLICATION.

1. Suppoſe a Perſon was born in the Year of our Lord ſeventeen Hundred and thirty-five, how old is he this preſent Year being 1784?
2. There are two Numbers, the greater is 102, and the leſſer 72, what is their Difference and Sum?
3. A. and B. having each a Sum of Money, A.'s Sum, which is the greateſt, is 74*l.* 17*s.* and the Difference of their Sums is 49*l.* 18*s.* 6*d.* I demand B's Sum?
4. Suppoſe I borrow 100*l.* and pay in Part 41*l.* 17*s.* 6*d.* how much remains to pay?
5. Suppoſe a Gentleman has an Eſtate of 600*l.* per Annum, and he pays Land-Tax 140*l.* alſo for Repairs 94*l.* 17*s.* 6*d.* what is his neat Eſtate per Annum?
6. A Perſon dying left 13111*l.* 10*s.* 6*d.* between his Son and Daughter; the Daughter was to have eleven Thouſand, eleven Hundred and eleven Pounds, what was the Son's Fortune?
7. A Horſe in his Furniture is worth 35*l.* 10*s.* out of it 12*l.* 12*s.* how much does the Price of the Furniture exceed that of the Horſe?
8. A Trader failing was indebted to A. 71*l.* 12*s.* 6*d.* To B. 34*l.* 9*s.* 9*d.* To C. 16*l.* 8*s.* 8*d.* To D. 44*l.* To E. 66*l.* 7*s.* 6*d.* To F. 111*l.* 2*s.* 3*d.* To G. 19*l.* 19*s.* And to H. a Fine of 30 Marks. At the Time of this Diſaſter he had by him in Caſh 3*l.* 13*s.* 6*d.* in Commodities he had 23*l.* 10*s.* in Houſhold Furniture 13*l.* 8*s.* 6*d.* in Plate 7*l.* 18*s.* 5*d.* in a Tenement 56*l.* 15*s.* in recoverable Book Debts 87*l.* 13*s.* 10*d.* Suppoſing theſe Things faithfully ſurrendered to his Creditors, what will they then loſe by him?
9. A. made a Bond for 114*l.* 10*s.* the Intereſt came to 19*l.* He then paid off 40 Guineas, and gave a freſh Bond for what was behind. By the Time there was 13*l.* 4*s.* 8*d.* due on the ſecond for Intereſt, he paid off 37*l.* 14*s.* 2*d.* more; took up the old Bond, and ſigned a new one ſtill for the Reſidue; the Principal again run on till there was 9*l.* 11*s.* 3*d.* more due, and then he determined to take it up; pray what Money had his Creditor to receive?
10. A Chaiſe, Horſe, and Harneſs, were altogether valued at 50*l.* the Horſe in Harneſs was worth 38*l.* 16*s.* 6*d.*

the

the Chaiſe and Harneſs were eſtimated at 13 Guineas; their ſeveral Valuations are required?

11. Received in Lieu of two Gold Repeaters, ſent to Jamaica in 1782, the five Cheſts of Indigo following; and on a like Adventure in 1784, the ſubſequent five Cheſts. The Queſtion is, how much Indigo I had leſs the ſecond Time than the firſt?

Anno 1782.	cwt.	qr.	lb.		lb. A. 1784.	cwt.	qrs.	lb.		lb.
No. 1.	2	1	16	Tare 4	3	1	3	7	Tare 3	2
2.	2	2	11		47	1	3	17		32
3.	2	0	12		41	1	2	10		30
4.	2	0	19		42	1	0	13		27
5.	2	3	17		49	2	0	11		34

12. A, B, and C, open an Account with a Banker, Jan. 11, 1784, and put into his Hands, viz. A. 17 Guineas, B. 34*l.* 11*s.* 6*d.* C. 28*l.* 18*s.* 10*d.* On the 21ſt, A. withdrew 9*l.* 10*s.* and C. advanced 12*l.* and a Crown. The 24th, B. called for 6*l.* 10*s.* The 30th, C. wanted 19*l.* 8*s.* 4*d.* On the 12th of Feb. B. depoſited with him eleven Carolus's, each 28*s.* and 3 Moidores. On the 19th, A. ſent for 5*l.* and a Noble more; but on the 24th returned him 42*l.* On the 2d of March, C. paid in twenty Guineas, and B. drew for ſix. The 14th B. ſent in 17*l.* 8*s.* 8*d.* and the 17th A. had back 12*l.* 2*s.* 6*d.* On the 19th they ſent for five Guineas a Man, and on the 24th they returned that Sum, and ten Marks a piece more: How much did their ſaid Banker owe them jointly and ſeparately at Lady-Day?

13. A Merchant taking an Inventory of his Capital, finds in his Vaults 28 Puncheons of Brandy, which coſt him 874*l.* 10*s.* 6*d.* Bourdeaux Claret, 40 Tuns, which ſtood him in 754*l.* 4*s.* 22 Laſts 4 Buſhels of Corn, in his Granary, worth 675*l.* 17*s.* 3*d.* with 2 Laſts of Canary Seed worth 113*l.* In his Warehouſe were ten Caſks of Indigo, worth 632*l.* 12*s.* A Parcel of Saffron, worth 253*l.* 5*s.* W. P. of Stafford owed him 384*l.* 10*s.* In the Hands of F. G. at Lynn, he had Wines to the Amount of 1011*l.* 10*s.* Pepper in the keeping of S. Q. of the Cuſtom-houſe, Value 1264*l.* 18*s.* 8*d.* beſides which R. O. owes him on Bond 300*l.* and T. M. on Note 460*l.* 14*s.* He has in India Bonds to the Value of 459*l.* and

the Intereſt of thoſe Securities made 25*l.* 14*s.* 6*d.* He had Bank-Stock to the Value 2134*l.* 4*s.* 6*d.* There lay in his Banker's Hands 1892*l.* 17*s.* 6*d.* He was at this Time indebted to D. E. 713*l.* 13*s.* To M. F. 352*l.* 10*s.* 8*d.* to L. P. the Foot of his Account, 172 Guineas. To J. B. on Balance 57*l.* 12*s.* 10*d.* To an Inſurance 190*l.* The preſent State of this Perſon's Fortune is required?

14. A Merchant at his out-ſetting in Trade owed 280*l.* He had in Caſh, Commodities, the Stocks, and good Debts, 11505*l.* 10*s.* He cleared the firſt Year by Commerce 393*l.* 13*s.* 1*d.* What was his neat Balance at the Year's End?

15. Received from my Factor at Alicant, on Account of Sales of Tin, to the Value of 197*l.* 12*s.* Sterling; of Bees-Wax to 71*l.* 7*s.* 6*d.* of Stockings to 47*l.* 3*s.* 6*d.* of Tobacco, the net Proceeds whereof were 943*l.* 15*s.* 10*d.* of Cotton 123*l.* 3*s.* 7*d.* and of Wheat to the Amount of 116*l.* 5*s.* 6*d.* He at the ſame Time adviſes, that he has, per Order, ſhipped, for my Account and Riſk, Alicant Wines to the Value of 226*l.* 16*s.* 6*d.* Figs, 150*l.* 11*s.* 3*d.* Fruit, 90 Cheſts coſt 104*l.* 6*s.* Olives, 136*l.* 10*s.* Oil, 193*l.* 17*s.* Raiſins, 143*l.* 4*d.* and Spaniſh Wool to the Value of 75*l.* 13*s.* 8*d.* The Commiſſion of the whole Conſignment came to 71*l.* 18*s.* 11*d.* The Queſtion is, which of us is to draw for the Difference, and how much?

16. Jacob by Contract was to ſerve Laban for his two Daughters 14 Years; and when he had accompliſhed 11 Years, 11 Months, 11 Weeks, 11 Days, 11 Hours, and 11 Minutes: Pray how long had he to ſerve?

17. W. X. Y. and Z. ſend their Money to the Bank, and draw upon it in the following Manner, viz. June 4, 1784, Z. ſent in 70*l.* 8*s.* Y. had 116*l.* 14*s.* 10*d.* remaining on Balance, and the 14th ſent in 120*l.* more. W. paid in 47*l.* 18*s.* 2*d.* in Caſh, and delivered a Bank Note for 200*l.* X. paid in a Bill of Exchange, on a good Man, for 33*l.* 14*s.* 9*d.* and in Caſh made it up 100*l.* Y. on the 16th drew for 43*l.* 12*s.* 6*d.* and the 20th Z. for eleven Guineas. W. on the 24th added 14*l.* 12*s.* 1*d.* and X. withdrew 47*l.* 10*s.* 8*d.* Y. on the 28th paid in 18*l.* 5*s.* and two Days after drew for 88*l.* 13*s.* 4*d.* W. ſent for 68 Guineas on the 30th, and in five Days after for 15*l.* 10*s.* 9*d.* more. Z. on the 7th of July, demanded

manded 12*l.* 8*s.* 3*d.* and X. 7*l.* 3*s.* 1*d.* Z. on the 15th, remitted them 31*l.* 12*s.* 4*d.* and per Aſſignment, they received for him at the ſame Time double that Sum. Y. required 81*l.* 19*s.* 8*d.* on the 12th, and W. ten Guineas. Y. three Days after that ſent in 42*l.* and W. 52*l.* On the 19th X. ſent for 38*l.* 18*s.* 10*d.* and the 24th paid in 19 Guineas. The Queſtion is, how ſtood theſe Gentlemen's Caſh ſeverally, and what Money can they jointly raiſe?

QUESTIONS for Exerciſe at Leiſure Hours.

18. Having a Piece of Ground 127 Feet in Front, let off to A. 57 Feet, to build on at 1 End; and to B at firſt 27½ Feet, which he afterwards, by Conſent, extended to 42 Feet: What Ground was left me in the Centre?

19. If I am 42 Years older than you now, what will be the Difference of our Ages 14 Years after my Deceaſe, in caſe you ſhould then ſurvive?

20. Of the noble Family of Cornaro, the Grandſire's Age was 134 Years, and he was 93 Years older than the Son, at the Time when the Son and Father's Ages together made 112 Years; diſtinguiſh their Ages.

21. B. was 14 Years old when C. was 25; how old ſhall C. be when B. comes to be 35?

22. What is the Difference between the Ages of A. born in the Year 1693, and B. that will be born 13 Years hence, the Queſtion being put in the Year 1779?

23. When the Air preſſes with its full weight, in very fair Weather, it may be demonſtrated, that there preſſes upon a human Body about 33905 Pounds of that fluid Matter; and in foul Weather, when the Air is moſt light, but 30624 Pounds. What Difference of Weight lies on ſuch a Body, in the two greateſt Alterations of the Weather?

24. Hipparchus and Archimedes of Syracuſe, about 200 Years before Chriſt, Poſidonius 50 Years before the ſaid grand Period, and Ptolemy 140 Years after it, all advanced the Science of Aſtronomy: How long did each of theſe Perſons flouriſh before the Year of Chriſt, 1784?

25. In the City of Pekin in China is a Bell, weighing, it is ſaid, 120000*lb.* at Nankin, in the ſame Country, is another weighing 50000*lb.* The firſt exceeds the great Bell at Erfurd, in Upper Saxony, by 94600*lb.* How much

then is the German Bell inferior in Weight to the Second?

26. Your Grandfather, if living, is 119 Years of Age, your Father actually 65; you are not ſo old as your Grandſire by 83 Years: What is the Difference in Years between your Father and you?

27. A Snail in getting up a May-pole, only 20 Feet high, was obſerved to climb eight Feet every Day; but every Night it came down again four Feet. In what Time by this Method did he reach the Top of the Pole?

28. A. is 13 Years younger than B. and 17 Years older than C. who in the Year 1747 was known to be 24 Years of Age: How old was each of theſe Perſons in 1784?

29. A public Edifice was finiſhed towards the Cloſe of the 10th of King John, who began his Reign 134 Years after the Conqueſt in 1066; and it ſtood till within 70 Years of the Peace of Utrecht, in 1713; of what Duration was it?

30. A Grant was made by the Crown, Anno 1239, which was forfeited 137 Years before the Revolution in 1688; how long did the ſame ſubſiſt?

31. Moſes was born Anno Mundi 2433; Hom[illegible]32 Years after him; Julius Cæſar lived 40 Years before our Saviour, and Alexander 312 Years before Cæſar; now as Chriſt was incarnate 4000 Years after the Creation, the Sum of the Intervals between Homer and the three great Perſonages laſt mentioned is required?

32. The Semi-diameter of the Earth's Orbit, or annual Path round the Sun, in the Centre of the Syſtem, is about 81,000,000 of Miles, that of Venus 59,000,000; when they are both on the ſame Side the Sun, they are in Perigæo; when on different Sides, in Apogæo: What is the Difference of their Diſtances in both theſe Circumſtances?

33. B. was born 14 Years after C. who came into the World 19 Years before A. who was 23 Years of Age eight Years ago: What then is the Age of D. who is within 22 Years of being as old as thoſe three together?

34. Arphaxad was born to Shem two Years after the Deluge, and 500 before his Father's Death; but at 35 Years of Age he had Selah, who at 30 was Father to Eber; who

at

at 34 had Peleg, and he lived 430 Years after that: The Question is, whether Shem or Eber died the first? and at nine Score and fourteen Years after the Death of the longest Liver, what Interval might be wanting to complete the Term of 1000 Years after the Flood?

35. K. is 19 Years older than L. who was 27 Years of Age in the South Sea Year, 1720: How old is M. in 1740, who, in the Year 1738, was within 24 Years of being as old as both of them together?

36. A. born Anno Christi 318, lived 207 Years before B. who lived 104 Years after C. who was Successor to D. 84 Years. E. was also 112 Years after D. but Predecessor to F. by 47 Years: In what Year of Christ did each of these Gentlemen flourish?

37. Sam was born 28 Years before Toby, who died at 12, and lived 19 Years after him. Rachel came to light when Sam was 26, and died 18 Years before him. Joshua, when Rachel was 7 Years, being himself then 14, went abroad, where he continued 9 Years, and returning, survived Rachel four Years: How old was each of these, and what is the Sum of their Ages?

38. B. born Anno 1108, lived 48 Years before C. who was 113 Years Senior to D. and X. was 114 Years before Y. who was 74 Years after Z. born Anno 1527. In what Years of Christ were these Men severally born?

39. You were born 34 Years after me: How old shall I be when you are 17? And how old will you be when I am 70 Years of Age?

40. Five notable Discoveries were made in 215 Years Time, viz. 1. The Invention of the Compass. 2. Gun-powder. 3. Printing. 4. The Discovery of America. 5. Truth, in the Reformation. The last was brought about Anno 1517, the third 77 Years before; the second 42 Years after the first, and the fourth 148 Years after the second: The Question is, in what Year of Christ did each of these happen to be found?

41. Three and thirty Years before the Restoration in 1660, the Crown granted Demesnes to certain Uses for 210 Years then to come. The Proprietor, in 1715, procured a reversionary Grant for 99 Years, to commence

after the Expiration of the First: In what Year of Christ will the second Term end?

42. A. was born when B. was 18 Years of Age; how old shall A. be when B. is 41? and what will be the Age of B. when A. is 72?

43. The Building of Solomon's Temple was in the Year of the World 3000: Troy was by Computation built 443 Years before the Temple, and 260 before London: Now Carthage was built 113 Years before Rome, founded 744 Years before Christ, born Anno Mundi 4000; is London or Carthage the ancienter City, and how much?

44. If the mean Distance between the Earth and Sun be 81 Million of Miles, and between the Earth and Moon 240 Thousands, how far are those two Luminaries asunder in an Eclipse of the Sun, when the Moon is lineally between the Earth and Sun? and in another of the Moon, when the Earth is in a Line between her and him?

45. From the Creation to the Flood was 1656 Years; thence to the Building of Solomon's Temple 1336 Years; thence to Mahomet, who lived 622 Years after Christ, 1630 Years: In what Year of the World was Christ then born?

46. Seth was born when Adam was 130 Years of Age, and 800 Years before our said Grandsire's Death: Seth at the Age of 105 Years had Enos: He, at 90, was Father to Canaan, who at 70 had Mahaleel. This Man at 65 begat Jared, who, having lived at 162 Years, was Father to Enoch: this Patriarch at 65 Years of Age had Methuselah; and by the Time he was 187 Years of Age, his Son Lamech came into the World, who at 182 Years old was Father to Noah; and when Noah was 600 Years old, the Flood swept away the Bulk of Mankind. In what Year of the World did this happen, and how long after the Death of Adam?

47. Miss Kitty told her Sister Charlotte, whose Father had before left them twelve Thousand twelve Hundred Pounds a-piece, that their Grandmother by Will had raised her Fortune to fifteen Thousand Pounds, and had made her own twenty Thousand: Pray what did the old Lady leave between them?

48. The Powder Plot was discovered 88 Years after the Reformation in 1517: The Murder of King Charles the First

First was committed 43 Years after that Diſcovery: The Acceſſion of the Bruniſwick Family to the Crown was in 1714; juſt 54 Years after the Return of King Charles the Second, who had lived in Exile ever ſince the Death of his Father, Charles the Firſt: How long was that?

49. B. born 161 Years ago, died when C. was 47 Years of Age, who it ſeems came into the World 180 Years ſince, and out-lived B. 43 Years; The Sum of their Ages is required?

50. If Sampſon was born 17 Years after Timothy, and Timothy 26 Years before Jacob, who 28 Years hence will be juſt 50. In what Year of Chriſt were they ſeverally born; the Queſtion being propoſed Anno 1784?

51. A. born 445 Years before the Year 1733, died Anno 1362; B. born 37 Years ago, will die 18 Years hence? C. born 256 Years ago, died 197 Years ſince; D. born Anno 1578, lived till within 75 Years of the ſaid 1733: The length of theſe People's Lives is ſeverally required?

52. A. born Anno 441, lived till B. was ſeven Years of Age, which was 23 Years before the Reformation in 1517. B. ſurvived this remarkable Æra juſt 49 Years; C. born 9 Years after the Death of A. lived but till B. was 36 Years of Age: The Sum of the Ages of theſe three Perſons is required?

53. A. born Anno 1438, died at 48 Years of Age: B. died Anno 1502, aged threeſcore and ſeventeen; C. in the Year 1577, was 22 Years of Age, and ſurvived that Time 54 Years; D. Anno 1616, had lived juſt Half his Time, and died in 1648; E. was 13 Years old at the Death of D. and 14 Years after that was Father to F. who was 31 when his Son G. was born, who at his Grandſire's Death was 7 Years of Age: The Years of Chriſt, wherein theſe Men were born, and the Years wherein the firſt five of them died, are ſeverally required?

54. A. born 17 Years after C. and 13 before B. died 42 Years before King George the Second's Inauguration in 1727, aged 47 Years; A. died Anno 1712, and B. exactly 6 Years before him; D. born 23 Years before C. died at 64; E. born 11 Years after B's Death, died 12 Years

after

after the Year 1733; and F. born just in the Midway of the Interval, between the Birth of A. and D's, is not to reach the Time of Death by 14 Years: What is the Sum of all their Ages, and which of them lived longest?

MULTIPLICATION.

EXAMPLES of INTEGERS.

(1)	14276084		4	(5)	147624		69
(2)	20749509	by	9	(6)	42768	by	748
(3)	1204674		12	(7)	10646		5278
(4)	4074746		16	(8)	14276		39674

Multiply

(9)	3142708		4678 52
(10)	27680709		40700609
(11)	2142760	by	4100
(12)	21700		954000
(13)	46904		27
(14)	10709		336

Multiply

CONTRACTIONS.

1. When the Multiplier consists of the same Figures in all the Places, (i. e.) all 9's or all 7's, &c. then for each Figure in the Multiplier, annex a Cypher to the Multiplicand, and if the repeating Figure is 9, the Remainder will be the Product required; but if any other Figure, multiply it into the ninth Part of the Remainder; or, for the Figure 3, take the third Part of the Remainder; and for 6, multiply the third Part by 2, which will give the required Number.

EXAMPLES.

Multiply

(1)	47627		9999
(2)	27464		11111
(3)	4674	by	2222
(4)	47694		7777
(5)	74760		3333
(6)	42763		6666

2. In many Cases the Work may be performed with more Ease, likewise more concise than is usually practised.

EXAMPLES.

(7) (8) Multiply { 4276 / 6946 } by { 126 / 486

9. COMPOUND MULTIPLICATION

Teacheth to multiply (by one common Multiplier) any Sum or Number consisting of divers Denominations. 1. When

1. When the given Quantity doth not exceed 12.

RULE.

1. Write the Multiplier (or given Quantity) under the loweſt Denomination of the Multiplicand.
2. Multiply the Number of the loweſt Denomination by the Multiplier, and divide that Product by as many of that as make one of the next higher Denomination the ſame which you ſtopped at in Addition, ſet down the Remainder underneath its own Place, and add the Quotient to the next ſuperior Denomination, as you multiply, in this Manner proceed with all the other Denominations to the higheſt.

EXAMPLES of MONEY.

	£.	s.	d.		£.	s.	d.		£.	s.	d.
(1) Multiply	14	17	11	(2)	140	10	$0\frac{1}{2}$	(3)	17	6	4
			2				6				9
Product											

4. 4 Yards of Cloth, at 17*s.* $6\frac{1}{2}$*d.* per Yard.
5. 5 Hundred of Cheeſe, at 3*l.* 0*s.* 6*d.* per Cwt.
6. 7 Ells of Holland, at 7*s.* 10*d.* per Ell.
7. 8 Pounds of Tea, at 18*s.* $9\frac{1}{2}$*d.* per lb.
8. 9 Gallons of Wine at 12*s.* 8*d.* per Gall.
9. 10 Anchors of Brandy, at 2*l.* 6*s.* 4*d.* per Anch.
10. 11 Barrels of ſmall Beer, at 12*s.* 7*d.* per Barrel.
11. 12 Firkins of Butter, at 1*l.* 17*s.* $6\frac{1}{2}$*d.*

2. When the given Quantity exceeds 12, and is ſuch a Number that any two Figures (in the Multiplication Table) being multiplied together will produce it:

RULE.

Multiply the given Price by one of thoſe Numbers, and the Product by the other, which will give the Anſwer.

EXAMPLES.

12. 14 Ounces of Silver, at 6*s.* $7\frac{1}{2}$*d.* per oz.
13. 18lb. of Sugar, at $10\frac{1}{2}$*d.* per lb.

14. 27 Quarters

14. 27 Quarters of Wheat, at *2l. 9s. 6d.* per Quar.
15. 30 Yards of German Serge, at *4s. 11½d.* per Yard.
16. 36 Stone of Wool, at *10s. 8d.* per ſt.
17. 45 Yards of Tape, at *2½d.* per Yard.
18. 50 Moidores, at *27s.* each.
19. 56 Yards of Shalloon, at *2s. 7½d.* per Yard.
20. 64 Firkins of Butter, at *1l. 11s.* per Firkin.
21. 72 Reams of Paper, at *15s. 9d.* per Ream.
22. 80 Yards of Yorkſhire Cambletz, at *11½d.* per Yard.
23. 84 Gallons of Oil, at *9s.* per Gallon.
24. 96 Yards of Indian Dimity, at *1s. 10½d.* per Yard.
25. 99 Yards of Broad Cloth, at *18s. 11½d.* per Yard.
26. 100 Yards of Cambric, at *11s. 10d.* per Yard.
27. 120 Hundred of the beſt Dutch Pens, at *1s. 6d.* per Hun.
28. 132 Deals, at *1l. 10d.* each.
29. 144lb. of Tobacco, at *1s. 7½d.* per lb.

3. When the given Quantity cannot be produced by the Multiplication of two ſmall Numbers.

RULE.

Find the neareſt Number to its leſs, by which multiply as before, then for what is wanting, multiply the Price by that Number, and add to it the laſt Product, and the Total will be the Anſwer.

EXAMPLES.

30. 17 Cwt. of Malaga Raiſins, at *1l. 4s. 10½d.* per Cwt.
31. 19lb. of fine Hyſon Tea, at *19s. 11½d.* per lb.
32. 29 Yards of Diaper, at *1s. 7½d.* per Yard.
33. 38 Dozen of Men's fine common Hoſe, at *2l. 17s. 6d.* per Dozen.
34. 47 Yards of flowered Linen, at *3s. 10d.* per Yard.
35. 58 Ells of Holland, at *10s. 4½d.* per Ell.
36. 67 Cwt. of Tobacco, at *5l. 17s.* per Cwt.
37. 73 Dozen of Soap, at *6s. 4½d.* per Dozen.
38. 86 Yards of green Silk Damaſk, at *19s. 1½d.* per Yard.
39. 106 of Vyſe's Tutor's Guide, at *3s. 6d.* each.

4. When the given Quantity conſiſts of ½, ¼, or ⅛.

RULE.

RULE.

Divide the upper Line (the Price of one) by 4 for $\frac{1}{4}$, by 2 for $\frac{1}{2}$, and for $\frac{1}{2}$, by 2 firſt for $\frac{1}{4}$; then divide that Quotient by 2, for $\frac{1}{8}$; add them to the Product, and the Sum will be the Anſwer required.

EXAMPLES.

40. $35\frac{1}{8}$ Tons of Hay, at 3*l.* 6*d.* per Ton.
41. $76\frac{1}{4}$ Dozen of Red Port, at 1*l.* 12*s.* 10*d.* per Dozen.
42. $17\frac{1}{8}$ Barrels of Ale, at 36*s.* $6\frac{1}{2}$*d.* per Barrel.
43. $8\frac{1}{4}$ Butts of Beer, at 4*l.* 6*s.* 7*d.* per Butt.
44. $100\frac{1}{2}$ Acres of Land, at 26*l.* 17*s.* 6*d.* per Acre.

This Method of finding the Value of any Quantity of Goods under 100, at any Price per yd. lb. &c. is of excellent Uſe to ſuch as buy or ſell by Retail.

But for great Quantities, there are other Methods much better. (See PRACTICE.)

Yet ſometimes it may ſo happen, that your given Quantity, though conſiderably great, may be wrought by the continual Product of three Numbers, as the following.

EXAMPLES.

45. 112 Buſhels of Oats, at 1*s.* $10\frac{1}{2}$*d.* per Buſhel.
46. 336 Yards of Dowlas, at 2*s.* 5*d.* per Yard.
47. 350 oz. of Cloves, at $11\frac{1}{2}$*d.* per oz.

Of WEIGHTS and MEASURES.

	Multiply		by	
(1)		14 lb. 10 oz. 0 dwts. 21 grs.		4
(2)		17 Tons, 17 cwt. 0 q. 24 lb.		2
(3)		14 cwt. 0 qr. 21 lb. 0 oz. 14 drs.		7
(4)		10 ℔. 6 ℥. 4 ʒ. 1 ℈. 17 grs.		9
(5)		127 yds. 0 qr. 3 na.		12
(6)		40 Ells Eng. 4 qrs. 2 na.		11
(7)		120 lea. 7 fur. 24 p.		5
(8)		147 yds. 2 f. 11 in. 2 b. c.		6
(9)		46 W. hhds. 47 gal. 7 pts.		3
(10)		6 Tuns, 1. p. 1 hhd. 46 gal. 3 qts.		8
(11)		27 ter. 41. gal. 2 qts.		6
(12)		4 B. hhd. 47 gal. 6 pts.		9
(13)		10 A. hhds. 17 gal. 3 qts. 1 pt.		4
(14)		12 B. bar. 2 fir. 7 gal. 7 pts.		6
(15)		140 A. 2 r. 26 p.		5
(16)		74 Laſt, 7 qrs. 4 bu. 1 p.		7
(17)		365 D. 5 h. 48 m. 57 ſec.		12

APPLI-

APPLICATION.

1. What Number taken from the Square of 54, will leave 19 Times 46?
2. Suppoſe 50 Men to take a Prize, and each Man's Share comes to 142*l.* What is the Value of the Prize?
3. What is the Difference, and what the Sum, of ſix dozen dozen, and half a dozen dozen?
4. A certain Iſland contains 52 Counties, every County 42 Pariſhes, every Pariſh 246 Houſes, and every Houſe 10 Perſons. I demand the Number of Pariſhes, Houſes, and Perſons that are in the whole Iſland?
5. What Difference is there between twice eight-and-twenty, and twice twenty-eight: As alſo, between twice five-and-fifty, and twice fifty-five?
6. By God's Bleſſing upon a Merchant's Induſtry, in ten Year's Time he found himſelf poſſeſſed of 13000*l.* it appeared from his Books, that the laſt three Years he had cleared 873*l.* a Year; the three preceding, but 586*l.* a Year, and before that, but 364*l.* a Year. The Queſtion is, what was the State of his Fortune at every Year's End that he continued in Trade, and what had he to begin with?
7. A Robbery being committed on the Highway, there was aſſeſſed on a certain Hundred, in the County of S. the Sum of 373*l.* 14*s.* 8*d.* of which the four Pariſhes paid 37*l.* 16*s.* 4*d.* the four Hamlets 28*l.* 3*s.* 10*d.* each, the 4 Townſhips 19 Guineas each: What was the Deficiency?
8. At Leiceſter and ſeveral other Places, they weigh their Coals by a Machine, in the Nature of a Steel-Yard, Waggon and all; three of theſe Draughts together amount to 137 cwt. 2 qrs. 10 lb. and the Tare or Weight of the Waggon was 13 cwt. 1 qr. How many Coals had the Cuſtomer to pay for?
9. A Perſon dying left his Widow 1780*l.* and 1250*l.* to each of his four Children, 30 Guineas a-piece to 15 of his poor Relations, and 150*l.* to Charities; he had been 25½ Years in Trade, and at an Average had cleared 126*l.* a Year: What had he to begin with?
10. Suppoſe a Gentleman's Income is 500*l.* per Annum, and he expends daily 19*s.* 1*d.* What doth he lay up at the Year's End?

If

11. If a Gentleman expendeth daily 1*l.* 12*s.* 6*d.* and at the Year's End layeth up 294*l.* 12*s.* 6*d.* I demand his yearly Income?

12. The Remainder of a Diviſion Sum is 20, the Quotient 423; the Diviſor is the Sum of both, and 19 more; what was the Number to be divided?

13. Suppoſe that for a Quarter's Rent I pay in Money ſeven Guineas and ſix Pence, and was allowed for ſmall Repairs 18*s.* 6*d.* for the King's Tax 8*s.* 9*d.* What did my Tenement go at a Year?

14. A Perſon dying left his Widow the Uſe of 5000*l.* To a Charity he bequeathed 846*l.* 10*s.* To each of his three Nephews 1230*l.* To each of his four Nieces 1050*l.* To 20 poor Houſe-keepers five Guineas each, and 200 Guineas to his Executor: What muſt he have died poſſeſſed of?

15. A Gentleman gave his Daughter to her Portion a Scrutoire, in which was twelve Drawers, in each of theſe are ſix Diviſions, and in each Diviſion there was 100*l.* a Moidore, and Half a Guinea: What was the young Lady's Fortune?

QUESTIONS for Exerciſe at Leiſure Hours.

16. The Silk Mill at Derby contains 26586 Wheels, and 97746 Movements, which wind off or throw 73726 Yards of Silk every Time the great Water Wheel, which gives Motion to all the reſt, goes about, which is three Times in a Minute. The Queſtion is, how many Yards of Silk may be thrown by this Machine in a Day, reckoning ten Hours to a Day's Work? and how many in the Compaſs of a Year, deducting for Sundays and great Holidays 63 Days; provided no part of it ſtands ſtill?

17. Trajan's Bridge over the Danube is ſaid to have had 20 Piers to ſupport the Arches, every Pier being 60 Feet thick, and ſome of them were 150 Feet above the Bed of the River; they were alſo 170 Feet aſunder: Pray what was the Width of the River in that Place; and how much did it exceed the Length of Weſtminſter Bridge, which is about 1200 Feet from Shore to Shore, and is ſupported by 11 Piers, making the Number of Arches 12?

18. There are two Numbers, the leſs is 187, their Difference 34: Required the Square of their Product, ditto of their Sum, and Difference, and Sum of thoſe Squares?

19. There are two Numbers, the bigger of them is 73 Times 109; and their Difference 17 Times 28. I demand their Sum and Product.

20. In the Partition of Lands in an American Settlement, A. had 757 Acres allotted to him; B. had 2104 Acres; C. 16410; D. 12881; E. 11008; F. 9813; H. 13800; and I. 8818 Acres. Now, how many Acres did the Settlement contain, ſince the Allotments made as above want 416 Acres of one fifth of the Whole?

21. How many different Ways can four common Dice come up at one Throw?—Note. One may come up ſix Ways.

22. In a Company S. had 3*l.* 11*s.* 2*d.* more than T. who had ſix Guineas leſs than R. who had within 16*s.* 8*d.* of as much as W. who was known to have 100 Guineas wanting ten Marks of 13*s.* 4*d.* each: Pray what Money had they among them?

DIVISION.

EXAMPLES of INTEGERS.

(1)		14076893		4.
(2)		30742165		12.
(3)		2410296		89.
(4)		98420649		576.
(5)		30876305		3029.
(6)		162212212499		46058.
(7)		51799555		127345.
(8)	Divide	7885599949 85	by	3090807.
(9)		1276421427		3700.
(10)		4074964478		827000.
(11)		24769851400		9300.
(12)		67402		14.
(13)		701747		63.
(14)		4170642		112.
(15)		2741724		336.

CONTRACTIONS.

When the Diviſor conſiſts of the ſame Figure in all the Places, that is, all 9's or all 7's, &c. annex as many Cyphers

Cyphers to Unity or 1, as there are 9's or 7's, &c. in the given Divisor, for a new Divisor; and if the repeating Figure is 9, divide the Dividend by that Divisor, and do the same with the Quotient, till you get 0, for an integral Quotient, then add all the Overpluffes together, and divide that Sum by the given Divisor, the Overplus thence arising is that required, and the Sum of all the integral Quotients is the Quotient required; for any other Figure, divide nine Times the Dividend so, and the integral Quotient by the repeating Figure: This gives the true integral Quotient; and if the 9th Part of the first Overplus be added to the Second, repeated as the given Figure, the Sum will be the true Overplus.

EXAMPLES.

		Divid.		by
(16)		4677823		999
(17)		2692464		1111
(18)		4769042		7777
(19)		109494		6666

10. COMPOUND DIVISION

Teacheth to divide (by one common Divisor) either a simple or compound Number, into any proposed Number of equal Parts, whereof each shall be a compound Number.

1. When the Divisor doth not exceed 12.

RULE.

1. Place the Divisor and Dividend as Integers.
2. Writing their Quotas under each respective Dividend.
3. But if there be a Remainder after dividing any of the Denominations except the least, you must find how many of the next lower Denomination it is equal to, by multiplying it by as many of the next less as make one of that, which add to the next (if any) and divide as before.

EXAMPLES of MONEY.

(1) 2)*l.* 14 *s.* 16 *d.* 10½

(2) 7)*l.* 267 *s.* 0 *d.* 0

(3) 8)171 11 4

(4) 9)317 0 6

(5) 11)6 6 11½

6. Bought 3 cwt. of Cheeſe, for which I gave 7*l.* 11*s.* 6*d.* at what Rate did I give per cwt.?
7. If 10 Dozen of Candles coſt 3*l.* 17*s.* 1*d.* what coſts one Dozen?
8. Suppoſe I give my Servant 14 Guineas per Year, what does his Monthly Wages come to?

2. When the Diviſor exceeds 12, and is ſuch a Number that if any two Figures (in the Multiplication Table) being multiplied together will produce it.

RULE.

Divide by component Parts, as in Sect. 5. Caſe 4.

EXAMPLES.

9. Divide 45*l.* 12*s.* 8*d.* into 16 equal Parts.
10. Divide 3*l.* 13*s.* equally amongſt 24 Perſons.
11. What is Cloth per Yard, when 36 Yards coſt 64*l.* 19*s.*
12. What is Tobacco per cwt. if 42 cwt. coſt 190*l.* 4*s.* 6*d.*
13. Bought 48 Yards of Broad Cloth for 37*l.* 14*s.* 8*d.* I deſire to know at what Rate I gave per Yard?
14. Suppoſe a Man ſpends 78*l.* 16*s.* 8*d.* in 8 Months Time, what is that per Week?
15. A Prize of 4567*l.* 0*s.* 10*d.* is to be equally divided amongſt 55 Perſons: What is each Man's Share?
16. What is Tea per cwt. when 63 cwt. coſt 264*l.* 12*s.*?
17. If 72 oz. of Silver coſt 18 Guineas, what is it per oz.?
18. Suppoſe I have 81 cwt. of Cheeſe, which coſt me 121*l.* 12*s.* 6*d.* at what Rate did I buy per cwt.?
19. Divide 174*l.* 1*s.* 8*d.* equally amongſt 120 Sailors.

3. When the Diviſor cannot be produced by the Multiplication of two ſmall Numbers. Divide as in Sect. 4. Caſe 2.

EX-

EXAMPLES.

20. Divide 214*l.* 17*s.* 9½*d.* equally among 17 Perſons.
21. Divide 476*l.* amongſt 145 People.

The following EXAMPLES require three DIVISIONS.

22. I gave 30*l.* 2*s.* for 112 Yards of Cambric, at what Rate did I give per Yard?
23. Divide 1009*l.* equally amongſt 350 Perſons.
24. Suppoſe the Cloathing of 224 Charity Children comes to 610*l.* 8*s.* what is the Expence of each?
25. Divide 1426*l.* equally amongſt 640 Perſons.

4. If the given Quantity or Diviſor conſiſts of ¼, ½, or ¾.

RULE.

Multiply the given Quantity by 4, adding to the Product 1 for ¼, 2 for ½, 3 for ¾; and it will give the Diviſor, which divide with as before, and the Quotient multiply by 4, will give the Anſwer.

EXAMPLES.

26. Suppoſe I give for 6¾ Yards of Cambric, 12*l.* 12*s.* 11*d.* at what Rate did I buy it at per Yard?
27. Suppoſe a Perſon in Trade to clear 1061*l.* 8*s.* 9¾*d.* equally in 10¾ Years, what was his yearly Increaſe of Fortune?
28. Suppoſe another to clear 450*l.* 12*s.* 11½*d.* equally in 8¾ Years, what was his yearly Profit?

Of WEIGHTS and MEASURE.

EXAMPLES.

(1)	8 lb. 1 oz. 15 dwts. 8 grs.		2
(2)	24 tuns, 14 cwt. 0 qr. 14 lb.		3
(3)	17 cwt. 2 qrs. 27 lb. 14 oz. 15 drs.		4
(4)	4 ℔. 11 ℥. 4 ʒ. 2 ℈. 12 grs.		6
(5)	214 yds. 3 qrs. 2 na.		9
(6)	120 ells Eng. 4 qrs.		8
(7)	12 lea. 2 m. 0 fur. 26 p.		9
(8)	147 yds. 2 f. 11 in. 2 b. c.		10
(9) Divide	24 W. hhds. 57 gal.	by	11
(10)	10 tuns. 1 p. 1 hhd. 60 gal. 3 qts.		8
(11)	16 tier. 20 gal. 7 pts.		6
(12)	76 A. hhds. 27 gal.		5
(13)	12 B. hhds. 49 gal. 2 qts.		4
(14)	61 B. bar. 2 fir. 6 gal.		3
(15)	140 acres, 2 r. 26 p.		12
(16)	60 laſts, 6 qrs. 17 bu. 2 pks.		7
(17)	146 days, 23 h. 24 m. 56 ſec.		6

APPLICATION.

1. An Army of 10,000 Men, having plundered a City, took 220,000*l.* What was each Man's Share?
2. A certain Man intending to go a Journey of 336 Miles, and would complete the ſame in twelve Days; it is required how many Miles he muſt travel each Day?
3. What Number added to the 43d Part of 4429 will make the Sum 240?
4. What Number deducted from the 26th Part of 2262 will leave the 87th Part of the ſame?
5. What Number multiplied by 72084, will produce 5190048 exactly?
6. What Number, divided by 419844, will quote 9494, and leave juſt a third Part of the Diviſor remaining?
7. The Sum of two Numbers is 360, the leſs is 144; what is their Difference, Product, and larger Quote?
8. The Spectator's Club of fat People, tho' it conſiſted but of 15 Perſons, is ſaid (No. 9) to weigh no leſs than 3 Tons: How much on an Equality was that per Man?

9. What

9. What Number is that, from which if you deduct the 25th Part of 22525, and to the Remainder add the 16th Part of 9696, the Sum will be 1440?
10. What Number, multiplied by 57, will produce juſt what 134, multiplied by 71 will do?
11. Subtract 30079, out of fourſcore and thirteen Millions, as often as it can be found, and ſay what the laſt Remainder exceeds or falls ſhort of 21180?
12. A Gentleman at his Death left his eldeſt Son, once and a half what he allotted his Daughter, and to the young Lady 1383*l.* leſs than her Mother; to whom he bequeathed four Times what he left towards the Endowment of Hertford College, Oxon. viz. 1640 Guineas, I require what he intended for his youngeſt Son, who claimed under the Will half as much as his Mother and Siſter? How much leſs than 30000*l.* did the Teſtator die worth, after his Debts and Funeral Expences, being 9881*l.* 10*s.* were paid?
13. My Purſe and Money, quoth Dick, are worth 12*s.* 8*d.* but the Money is worth ſeven Times the Purſe: Pray what was there in it?
14. A young Fellow owed his Guardian 74*l.* 18*s.* 2*d.* on Balance. He paid off 41*l.* 14*s.* 8*d.* and then declared his Siſter owed the Gentleman half as much again as himſelf: On hearing this ſhe pays off in Part 13*l.* 12*s.* 10*d.* and gives out that her Uncle William was not then leſs in Arrear than her Brother and ſhe together. The Uncle hereupon pays in 24*l.* 7*s.* 3*d.* and then the Uncle's Brother, who, by the bye, was not the Uncle of thoſe Children, for 150*l.* undertakes to ſet them all clear, and has 35*l.* 15*s.* 5*d.* he ſays, to ſpare: Can that be true?
15. A dealer bought two Lots of Snuff, that together weighed 9 cwt. 3 qrs. 16 lb. for 97*l.* 17*s.* 6*d.* their Difference in point of Weight, was 1 cwt. 2 qrs. 16 lb. and of Price 8*l.* 13*s.* 3*d.* Their reſpective Weights and Values are required?
16. A Father left among ſeven Sons and a Daughter, an Eſtate conſiſting of 10,000*l.* in Caſh, with 8 Bills each 54*l.* 10*s.* 6*d.* He ordered 30*l.* to be beſtowed upon his Burial, and his Debts to be paid, amounting to 260*l.* then his free Eſtate to be divided in this Manner, viz. the Daughter to have the 9th Part, and the ſeven Sons

to have equal Shares: What is the Daughter's Part, and alſo what is the Share of each Son?

QUESTIONS for Exerciſe at Leiſure Hours.

17. I would plant 2072 Elms, in 14 Rows, twenty-five Feet aſunder: How long muſt the Grove be?

18. A Brigade of Horſe, conſiſting of 384 Men, is to be formed into a long Square, having 32 Men in Front: How many Ranks will there be?

19. Divide 1000 Crowns, betwixt A. B. and C. in ſuch a Manner, that A. may have 129 more than B. and B. 178 leſs than C.

20. Part 250*l.* give A. 37 more than B. and let C. have 28 fewer.

21. Six of the Female Cricketters that played lately in the Artillery Ground, fetched in Company Strokes as follows, viz. A. B. C. D. E. 207. A. C. D. E. F. 213. A. B. D. E. F. 189. A. B. C. E. F. 234. A. B. D. C. F. 222. B. C. D. E. F. 250. How many did they fetch on the other Side, ſince theſe ſix Perſons wanted but fourſcore and 13 Notches to decide the Game?

22. In order to raiſe a joint Stock of 10,000*l.* L. M. and N. together ſubſcribed 8,500*l.* and O. the reſt: Now M. and N. are known together to have ſet their Hands to 6,050*l.* and N. has been heard to ſay, that he had undertaken for 420*l.* more than M. What did each Proprietor advance?

23. There are two Numbers, whoſe Product is 1610, the greater is 46: What is their Sum, Difference, and Quotes, what is the Sum of their Squares, and what is the Cube of their Difference?

24. There are other two Numbers, the greater 7050, which divided by the leſs, Quotes 94; what is the Difference of their Squares; and what's the Square of the Product of their Sum and Difference?

25. What Difference will there be to the Proprietors of an Aqueduct, between doubling an Expence, and halving a Profit.

26. Part 1500 Acres of Land, give B. 72 more than A. and C. 112 more than B.

27. One of the Smarts in the Accomptant's Office, making his Addreſſes in an old Lady's Family, who had five fine

fine Daughters; they told him their Father had made a whimſical Will, which might not ſoon be ſettled in Chancery, and till then he muſt refrain his Viſits. The young Gentleman undertook to unravel the Will, which imported, That the firſt four of her Girl's Fortunes were together to make 25000*l.* the four laſt 33000*l.* the three laſt, with the firſt 30000*l.* the three firſt, with the laſt, were to make 28000*l.* and the two laſt and two firſt 32000*l.* Now, Sir, if you can make appear what each is to have, and as you like, ſeemingly, my third Daughter, Charlotte, I am ſure ſhe will make you a good Wife, and you are welcome: What was Miſs Charlotte's Fortune?

28. By ſelling 240 Oranges at five for 2*d.* 120 of which coſt me two a Penny, and the other Half three a Penny, I evidently loſe a Groat: Pray how comes that about?

29. A. B. and C. play in Concert at Hazard; and at making up Accompts, it appears, that A. and B. together brought off 13*l.* 10*s.* B. and C. together 12*l.* 12*s.* and A. and C. together won 11*l.* 16*s.* 6*d.* What did they ſeverally get?

30. Four Perſons advance in Trade, as follows, viz. W. X. and Y. raiſed 350*l.* 10*s.* W. X and Z. 344*l.* 10*s.* X. Y. and Z. made up together 400*l.* and W. Y. and Z. contribute 378*l.* 4*s.* In the concluſion they parted with their joint Property for 450 Guineas: What did they gain or loſe by their Adventure?

31. A Tradeſman increaſed his Eſtate annually a third Part, abating 100*l.* which he uſually ſpent in his Family, and at the End of 3¼ Years, found that his neat Eſtate amounted to 3179*l.* 11*s.* 8*d.* Pray what had he at outſetting?

32. Ten Pounds a Quarter is allowed to five Auditors of a Fire-Office. They attend about ſeven Times in the Quarter, and the Abſentees Money is always divided equally among ſuch as do attend. A. and B. on theſe Occaſions, never miſs, C. and D. are generally twice in a Quarter abſent, and E. only once: At the Payment, what had each Man to receive?

33. Suppoſe a Maid, carrying Apples to a Market, was met by three Boys, and that the firſt took half what ſhe had,

but

but returned her back 10, that the second took one-third, but returned two; lastly, the third took away half those she had left, but returned her one, and when she had got clear she had 12 Apples left: What Number of Apples had she at first?

REDUCTION.

In this, and all the following Rules, all great Names are brought into small by Multiplication; on the contrary, all small Names into great by Division (6).

EXAMPLES of MONEY.

1. In 130*l.* how many Shillings, Pence, and Farthings?
2. How many Pence, Shillings, and Pounds, are in 24000 Farthings?
3. In 80*l.* 15*s.* 11½*d.* how many Farthings?
4. Reduce 16921 Farthings to Pounds.
5. Reduce 110*l.* 0*s.* 6½*d.* to Halfpence.
6. How many Pounds, &c. are there in 20553 Halfpence?
7. In 107*l.* 10*s.* 8*d.* how many Two-Pences?
8. Reduce 5348 Two-Pences to Pounds.
9. Reduce 6*l.* 17*s.* to Three-Pences.
10. In 2782 Three-Pences, how many Pounds, &c.?
11. In 10*l.* 10*s.* 8*d.* how many Four-Pences?
12. Reduce 3859 Four-Pences to Pounds.
13. How many Six-Pences are there in 200*l.* 17*s.*?
14. Reduce 795 Six-Pences to Pounds, &c.
15. In 21 Guineas, how many Shillings, Pence, and Farthings?
16. How many Guineas in 24192 Farthings?
17. In 12 Moidores how many Farthings?
18. How many Moidores are there in 3240 Pence?
19. In 30*l.* how many Crowns, Half-Crowns and Pence?
20. Reduce 20160 Pence to Half-Crowns, Crowns, and £.
21. In 25 Crowns how many Shillings, Groats, and Pence?
22. Reduce 25200 Pence to Groats, Shillings, and Crowns.
23. In 25*l.* how many Shillings, Crowns, and Pence?
24. How many Shillings and Pounds in 80 Crowns?
25. How many Crowns, Half-Crowns, and Shillings, are in 213*l.* 15*s.* 6*d.* and of each an equal Number?

26. In

26. In 120*l.* how many Half-Crowns, Crowns, Groats, and Shillings?

27. In 36 Crowns, as many Half-Crowns, Shillings, and Groats, how many Pounds?

28. Reduce 470*l.* 17*s.* to Shillings and Moidores?

29. Reduce 240 Guineas to Shillings, Crowns, and Pounds.

30. In 21 Purſes, each Purſe with 21 Guineas, a Crown, and a Moidore in, what Sterling do they contain?

COINS.

1. To Reduce Foreign and Engliſh Coin to Pounds Sterling.

RULE.

Multiply the given Number of Pieces, by the Shillings, Six-Pences, Four-Pences, Three-Pences, Two-Pences, Pence, or Halfpence, &c. that are in one Piece, and the Product will be according, which bring into Pounds Sterling.

EXAMPLES.

31. How many Pounds Sterling are there in 1178 Dollars, at 4*s.* 3*d.* each?

32. In 470 Piſtoles, each 17*s.* 6*d.* how many Pounds Sterling?

2. To Reduce Pounds Sterling into Foreign and Engliſh Coin, &c.

RULE II.

Reduce the given Pound Sterling, and the given Coin, into one Name, that is, if you can reduce them both into Shillings, Six-Pences, Four-Pences, or Three-Pences, &c. do ſo; then divide one by the other, and the Quotient will be the Anſwer.

EXAMPLES.

33. A Merchant is to pay 249*l.* 7*s.* 6*d.* With how many Quarter Guineas can he do it?

34. In

34. In 387*l.* 18*s.* 4*d.* how many Florins at 3*s.* 2*d.* each?

3. To reduce one Kind of Coin into another Kind of Coin.

RULE.

To reduce both Coins into the ſame Denomination, and then divide one by the other.

EXAMPLES.

35. How many Crowns of 5*s.* 4*d.* each, are in 474 Piſtoles of 18*s.* 6*d.* each?

36. How many Guineas are equal in Value to 1240 Moidores?

Of WEIGHTS and MEASURES.

1. In 14 lb. of Silver, how many Ounces, Penny-weights, and Grains?
2. How many lb. of Silver are there in 138240 grs.?
3. In 19 lb. 10 oz. 17 dwts. 22 grs. how many Grains?
4. Reduce 74342 grs. to Pounds.
5. In 4 Ingots of Silver, each weighing 4 lb. 6 oz. 22 grs. how many Grains?
6. How many Ingots of 6 lb. 11 oz. 14 dwts. each, are there in 241056 grs.?
7. How many lb. of Silver are there in one Dozen of Diſhes, each weighing 25 oz. 15 dwts. and one Dozen of Plates, each weighing 15 oz. 15 dwts. 22 grs?
8. A Gentleman ſent 455 oz. 1 dwt. 16 grs. of old Plate, to his Silverſmith, with Orders to make it into the following Articles, viz. Punch Bowls, each 24 oz. 4 dwts. Tankards, each 11 oz. 14 dwts. Tea-pots, each 10 oz. 10 dwts. Lamps, each 20 oz. 17 dwts. 21 grs. Plates, 127 oz. 11 dwts. per Dozen. Spoons, of 36 oz. 17 dwts. 23 grs. per Dozen. How many of each muſt he make, ſuppoſing for every Dozen of Plates and Spoons he is to make one of each of the other?
9. In 4 ℔. 10 ℥. 4 ʒ. 1 ℈. 12 grs. how many grs.?
10. Reduce 59934 grs. to ʒ. and ℔.
11. In 6 Tons, how many cwts. qrs. and lb.?
12. How many Tons in 26880 lb.?

13. Reduce

13. Reduce 74 cwt. 2 qrs. 16 lb. 7 dr. to Drams.
14. In 29768 oz. how many Hundred Weight?
15. Reduce 67 lb. 12 oz. 15 drs. to Drams.
16. In 6 hhds. of Tobacco, each weighing net 6 cwt. 3 qrs. 27 lb. how many Pounds?
17. How many hhds. of Sugar, each weighing 11½ cwt. are there in 12880 lb.?
18. In 507 cwt. of Lead how many Fother?
19. Out of 12 cwt. 3 qrs. 12 lb. of Tea, how many Canifters can I fill, each Canifter holding 12 lb.
20. How many Parcels, each 126½ lb. can I have out of one hhd. of Sugar weighing net 8½ cwt.?
21. How many Parcels of 6 lb. 8 lb. 12 lb. and 16 lb. can a Grocer have out of two hhds. of Tobacco, each weighing net 4 cwt. 3 qrs. 24 lb. and to have of each a like Number?
22. Reduce 24 great Pounds, at 24 oz. each, to common Pounds, at 16.
23. In 120 common Pounds, how many great Pounds?
24. In 27 yds. 3 qrs. of Cloth, how many Nails?
25. How many Yards in 352 Nails?
26. Reduce 30 Eng. Ells, 4 qrs. 3 na. to Nails.
27. In 569 Nails how many Fl. Ells?
28. In 14 Pieces of Cloth, each 24 yds. how many Nails?
29. Reduce 24768 Nails to Pieces, each 12 Yards.
30. In 12 Pieces of Cloth, each containing 20 Flem. Ells, how many Ells Engliſh?
31. How many Pieces of Cloth, each 24 Ells Flemiſh, are there in 227 Yards?
32. In 4 Bales of Cloth, each 12 Pieces, and each Piece 24 Ells Fl. how many Ells Engliſh?
33. In 60 Miles how many Furlongs and Poles?
34. Reduce 12800 Poles to Miles.
35. In 16 Miles, how many Feet, Inches, and Barley-Corns?
36. Reduce 2280060 Barley-Corns to Miles.
37. How many Barley-Corns will reach from London to Newcaſtle upon Tyne, being 276 Miles?
38. How many Times doth the Wheel which is 18½ Feet in Circumference, turn between London and York, being 197 Miles?
39. How many Barley-Corns will reach round the Terreſ-

trial Globe, which is 360 Degrees, and each Degree 69½ Miles?

40. In 64 Acres of Land how many Roods and Poles?
41. Reduce 21760 Poles to Acres.
42. A common Field, containing 774 Acres, is to be divided into Shares of 270 Perches each, how many Shares doth the whole contain?
43. A Perſon rents a Farm, which contains 200 Acres of Land, but he is to till no more than 96½ Acres, I deſire to know how many Perches there are in the Remainder?
44. In 12 Tierces of Wine, how many Gallons and Pints?
45. How many Tierces in 6048 Pints?
46. In 4 hhds. 42 gal. 2 qts. of Wine, how many Quarts?
47. How many hhds. of Wine in 5746 Pints?
48. A Gentleman ordered his Butler to bottle off a Pipe of red Port into Quart Bottles, how many Dozen will the ſaid Pipe fill?
49. In a Tun of Oil how many Quarts, Pints, and Half-Pints, and of each an equal Number?
50. How many Pipes, Puncheons, Hogſheads, and Tierces, and of each a like Number, are there in 1890 Gallons?
51. In 12 Barrels of Ale, how many Gallons and Pints?
52. How many Barrels of Ale in 1704 Pints?
53. In 6 bar. 2 fir. 7 gal. of Beer, how many Gallons?
54. In ten hhds. 42 gal. 4 pts. of Ale, how many Pints?
55. In 2017 qts. of Ale, how many hhds.?
56. In 12 hhds. of Beer, how many Barrels?
57. In 18 Barrels of Ale, how many hhds.?
58. In 4 Tuns, 1 b. 1 hhd. 49 gal. of Beer, how many hhds. bar. and fir. and of each a like Number?
59. Reduce 24 qrs. of Wheat to Buſhels, Pecks, and Gallons.
60. In 3360 Gallons of Corn how many Quarters?
61. How many Quarters and Buſhels are there in 42 la. 4 qrs. 7 bu. of Wheat?
62. In 40 Chaldron of Coals, how many Buſh. and Pecks?
63. How many Chaldron of Coals are there in 4762 Buſh.?
64. In 47 cha. 30 buſh. of Coals, how many Sacks, each 3 Buſhels?
65. How many Chaldron of Coals are there in 6450 Sacks, each 3 Buſhels?

66. How

66. How many Minutes are there in a Julian Year?
67. Reduce 2073600 Seconds to Days.
68. In a Lunar Month, or 27 d. 7 h. 43 m. 5 ſec. how many Seconds?
69. How many Thirds are there in a Solar Year?
70. In 31557600 Seconds how many Days?
71. How many Days is it ſince the Birth of our Saviour to Chriſtmas, 1784, (allowing Julian Years)?
72. Suppoſe London was built in 1108 Years before the Birth of our Saviour; how many Days is it ſince to Chriſtmas, 1784, (allowing the Year as before)?

2. The RULE of THREE DIRECT

Teacheth by three Numbers given to find a fourth in ſuch Proportion to the Third as the Second is to the Firſt, for which Reaſon it is termed the RULE of PROPORTION, as it is called the RULE of THREE, from its having three Numbers given; and becauſe of its excellent and extenſive Uſe in Arithmetic, it is often named the GOLDEN RULE.

To perform which obſerve the following

RULE.

1. State or place the Numbers in ſuch Order, that the firſt and third Terms be of the ſame Kind; and the ſecond of the ſame with the Number required.
2. If your firſt and third Terms conſiſt of divers Denominations, reduce them into one, and the Second into the loweſt Name mentioned.
3. Multiply the ſecond and third Terms together, and divide that Product by the Firſt, the Quotient will be the Anſwer to the Queſtion in the ſame Denomination or Name you left your ſecond Term in.
4. If there happens to be a Remainder after the Diviſion, reduce it into the next Denomination below the laſt Quotient, and divide by the ſame Diviſor, the Quotient will be ſo many of the ſaid next Name; proceed in this Manner to the leaſt Name, and all the Quotients together will be the Anſwer.

EXAMPLES.

1. If 3 Yards of Cloth coſt 18*s.* what will be the Value of 17 Yards, at the ſame Rate?
2. If 2 lb. of Sugar coſt 1*s.* 6½*d.* what will 24 lb. of the ſame coſt?
3. If 4 lb. of Candles coſt 2*s.* 6*d.* what will 6 Dozen coſt at the ſame Rate?
4. If 1 cwt. of Cheeſe coſt 26*s.* what will 40 cwt. of the ſame come to?
5. Suppoſe I give 7½*d.* for 1 oz. of Coffee, what muſt I pay for 1 cwt.?
6. Bought 36 oz. of Silver at the Rate of 5*s.* 4*d.* per Ounce, what does the whole come to?
7. If I buy 12 Pieces of Cloth, and each Piece contains 30 Yards, at 17*s.* 6*d.* per Yard; what is the Value of the whole?
8. Bought 1 cwt. of Tea, for which I was to give at the Rate of 7*s.* 9*d.* per lb. what doth the whole ſtand me in?
9. A Grocer bought 2 cwt. 1 qr. 14 lb. Weight of Cloves, which coſt him 34*l.* 6*s.* and he would gain 6*l.* by the Bargain, at what Rate muſt he ſell them at per lb.?
10. Suppoſe I have by me 200 Yards of Cambric, which coſt me 90*l.* but ſome Damage having happened to it, I am willing to loſe 7*l.* 10*s.* by the whole; at what Rate then muſt I ſell it per Ell Engliſh?
11. If 9 Dozen Pound of Candles coſt 2*l.* 5*s.* what will 4 lb. of the ſame coſt?
12. A Grocer bought 4 hhds. of Sugar, each weighing net 12 cwt. 2 qrs. 24 lb. and gave after the Rate of 6½*d.* per lb. I demand what the 4 hhds. came to?
13. A Merchant at London buys 46 Tuns of Port Wine, which coſt him 575*l.* 12*s.* the Freight thereof from Port to London coſt 46*l.* the Loading and Unloading 6*l.* Cuſtom 10*l.* the Charge of the Cellar 4*l.* and he would gain 360*l.* by the Bargain.

   A Gentleman comes to him and demands the Price of 26 Tuns of the ſaid Wine: Quere, what muſt he give?
14. A Factor bought of a Farmer 12 cwt. 2 qrs. 14 lb. of Cheeſe, and was to give 32*s.* 6*d.* per cwt. what muſt the Farmer receive for his Cheeſe?

15. If

15. If 1 cwt. of Tea coſt 89*l.* 16*s.* 4*d.* at what Rate muſt it be ſold per lb. to loſe by the whole 12*l.*
16. If in four Months I ſpend as much as I gain in three, how much do I lay by at the Year's End, if I gain every 6 Months 185*l.* 5*s.* 6*d.*?
17. How many Dozen Pair of Gloves, at 16*d.* per Pair, will pay for 36 Dozen and 8 Pair of Stockings, at 4*s.* 6*d.* per Pair?
18. Bought a Parcel of Cloth at the Rate of 6*s.* 6*d.* for every two Yards, of which I ſold a certain Quantity at the Rate of 18*s.* 9*d.* for every 5 Yards, and gained thereby as much as 180 Yards coſt, now I demand how many Yards I ſold?
19. How many Pieces of Holland, each 20 Ells Flem. may I have for 23*l.* 8*s.* at 6*s.* 6*d.* per Ell Engliſh?
20. How many Ingots of Silver, each 4 lb. 1 oz. 14 dwts. can I buy for 102*l.* 16*s.* 6*d.* ſuppoſing I gave at the Rate of 5*s.* 10*d.* per Ounce?
21. Suppoſe I give at the Rate of 8½*d.* per oz. for Coffee, how many Parcels, each 1 cwt. can I have for 426*l.* 16*s.*?
22. A Gentleman having an Eſtate of 438*l.* 5*s.* per Ann. he is deſirous to know how much he may ſpend daily, ſo that he may lay up 100 Guineas at the Year's End?
23. Suppoſe a Gentleman has an Eſtate of 564*l.* 12*s.* per Ann. and he is rated at 3*s.* 9*d.* per Pound for the Land-Tax. Quere, his net yearly Income?
24. Suppoſe I give 5*s.* 9*d.* for 1 oz. of Silver, how many Ingots, each weighing 2 lb. 10 oz. 12 dwts. may I have for 200*l.*
25. A Draper bought of a Merchant 6 Packs of Cloth, every Pack had 6 Parcels, and each Parcel contained 10 Pieces, every Piece was 30 Yards; he gave after the Rate of 2*l.* 4*s.* 3*d.* for 3 Yards: I deſire to know what the 6 Packs coſt him per Yard?
26. If 16 Weeks Pay comes to 14*l.* 16*s.* what is that per Year?
27. A Butcher goes with 116*l.* 14*s.* to Smithfield Market, and buys Cattle at the following Prices, viz. Oxen at 10*l.* each, Cows at 7*l.* each, Calves at 1*l.* 10*s.* each, Sheep at 19*s.* each, and of each the ſame Number: how many of each Sort will the ſaid 116*l.* 14*s.* buy?
28. A Perſon failing in Trade owed me 560*l.* for which I

received only 374*l.* 10*s.* 6$\frac{3}{4}$*d.* at what Rate did I receive per Pound?

29. The net Proceeds of a hhd. of Barbadoes Sugar, wt. 18 cwt. 3 qrs. 17 lb. 7 oz. was 4*l.* 14*s.* 6*d.* the Cuſtom and Fees 2*l.* 8*s.* 6*d.* Freight 1*l.* 2*s.* 8*d.* Factorage 4*s.* 6*d.* Pray how muſt I ſell it at per cwt. ſo that I may gain 5*l.* 10*s.* by the whole?

30. A certain Tower projected upon level Ground a Shadow, to the Diſtance of 63 Yards 1 Foot, when a Staff, 3 Feet in Length, perpendicular erected, caſt a Shadow of 6 Feet 4 Inches, from hence the height of the Tower is required?

31. Suppoſe a Perſon travels 285 Miles in 6 Days, 4 Hours, at what Rate is that per Hour, (allowing 12 Hours to the Day)?

32. Suppoſe I give 44*l.* 2*s.* for one Pipe of Wine, at what Rate did I give per Pint?

33. The Globe of the Earth, under the equinoctial Line, is 360 Degrees in Circumference; and this Body being turned on its own Axis, in the ſydereal Day or 23 Hours, 56 Minutes, at what Rate an Hour are the Inhabitants of Bencoolen, (ſituated in the Midſt of the Torrid Zone) carried from Weſt to Eaſt by this Rotation?

34. What is the Value of one Grain of Gold, when one Ounce coſts 5 Guineas?

35. If 12 Apples are worth 21 Pears, and 3 Pears coſt a Halfpenny, what will be the Price of fourſcore and four Apples?

36. It is a Rule in ſome Pariſhes to aſſeſs the Inhabitants in Proportion to Eight-tenths of their Rents: What is the yearly Rent of that Houſe, which pays 8*l.* 10*s.* to the King under this Limitation, at 4*s.* in the Pound?

37. If 19 Yards of Yard-wide Stuff exactly line 14 Yards of Silk of another Breadth, how many Yards of the latter will line 184 Pieces of the former, each Piece holding 28$\frac{1}{2}$ Yards?

38. In 117 Times 406 Pieces of Coin, worth 3*s.* 8*d.* a piece, how many Reas at 20 for 3*d.* Engliſh?

39. A Merchant bought 274 Ells Flemiſh, of Holland, for 4*s.* per Ell, and ſold it again for 7*s.* 10*d.* per Ell Engliſh, what did he gain by the whole?

40. A

40. A May Pole 50 feet 11 inches long, when the Sun is on the Meridian, will caſt a Shadow 98 Feet 6 inches long; I would thereby find the Breadth of a River, that running due E. and W. within 20 Feet 6 Inches on the North Side of the Foot of a Steeple, 300 Feet 8 Inches high, which at the ſame Time throws the Extremity of its Shadow 30 Feet 9 Inches beyond the Stream?
41. If two Men in three Days will earn 15*s.* how much will ſeven Men earn in the ſame Time?
42. How far will one be able to travel in 9 Days 8 Hours, at the Rate of 12 Miles every 4 Hours, allowing 12 Hours to a travelling Day?
43. What will 1000 Yards of Walling amount to, at the Rate of 4*s.* 6*d.* per Rod?
44. A Factor bought 64 Pieces of Holland, which coſt him 352*l.* at 5*s.* 6*d.* per Ell Flemiſh; I demand how many Yards there were in all, and how many Ells Engliſh in each Piece?
45. If 100*l.* in 12 Months gain 4*l.* 15*s.* what will 40*l.* 10*s.* gain in the ſame Time, the Intereſt being at the ſame Rate?
46. If 12 Yards of Yard-wide Stuff exactly line 8 Yards of Silk of another Breadth; how many Yards of the latter will line 24 Pieces of the former, each Piece containing 20 Yards?
47. What is the Quarter's Rent of 240 Acres of Land, at 1*l.* 19*s.* 6*d.* per Acre per Annum?
48. A Perſon owes 1000*l.* but not being able to pay the whole, compounds with his Creditors for to pay them Half a Guinea in the Pound, how much Money doth he pay his Creditors?
49. When the Sun is in the Meridian at Soho-Square, in what Time will it be ſo at Tyburn, lying due Weſt of it at the Diſtance of a meaſured Mile, in the Latitude of 51½ Degrees North, where a Degree of Longitude meaſures 37 Miles, 2 Furlongs, 37 Poles, 5 Feet and 6 Inches, known by the diurnal Rotation of the Earth to paſs in 4 minutes Time?
50. How many Pieces of Holland, each 33 Ells Flem. 1 qr. 2 na. can I have for 118*l.* 17*s.* 7½*d.* when 4 Ells Engliſh coſt 1*l.* 7*s.* 10*d.*
51. I laid out 100*l.* upon Serges and Shalloons; the total Value of the Shalloons was 60*l.* and the total Quantity

tity of Serge 236 Yards; alſo for every two Yards of Serge, I had three of Shalloon: how much Shalloon was there, and what was the Value of one Yard of each Sort?

52. If 14*s.* will buy 8 lb. of Tobacco, how much will 4*l.* 19*s.* 1¼*d.* buy at the ſame Rate?

53. What will the Carriage of 20 cwt. 2 qrs 16 lb. come to, at 7*s.* per cwt.?

54. Bought a Pipe of Port Wine, for which I gave 25*l.* 4*s.* but it leaked out 12 Gallons; the Remainder I ſold at the Rate of 18*d.* per Quart; what was my Gain or Loſs in the Whole?

55. If 7*l.* 4*s.* 9*d.* be paid for the Carriage of 20 cwt. 2 qrs. 16 lb. at what Rate is that per Pound?

56. How many Bricks, 9 Inches long, and 4 Inches wide, will floor a Room that is 20 Feet ſquare?

QUESTIONS for Exerciſe at leiſure Hours.

57. I am diſpatched on a Commiſſion from London to Edinburgh, diſtant by Computation ſay, 350 Miles, and my Route is ſettled at 22 Miles a Day; you, 4 Days after, are ſent after me with freſh Orders, and are to travel 32 Miles a Day; whereabout on the Road ſhall I be overtaken by you?

58. In the Year 1582 Pope Gregory reformed the Julian Kalendar, ordaining, that as the Year is found to conſiſt only of 365 Days, 5 Hours, and about 49 Minutes, in order to prevent the Inconvenience of carrying the Account of Time too forward, by taking the Solar Year at 365 Days and 6 Hours full, which in a Series of Years muſt bring Lady-Day to Michaelmas, that the Chriſtian States for the future ſhould drop three Days in Account every 400 Years: that is to ſay, for each of the firſt three Centuries in that Space of Time, the intercalary Day in February ſhould be omitted, but retained as formerly in the laſt Century, beginning with the Year 1700, when 10 whole Days were ſunk at once, by which Artifice the Variation of Time will not, at leaſt for a long Space, be very conſiderable: according to this Regulation, it is required to ſhow in what Year of Chriſt, the New Style, as it is called, will be twenty Days,

Days, as it is now only 11, before the Old Style, which makes no ſuch Allowance?

59. Suppoſe the Sea Allowance for the common Men to be 5lb. of Beef, and 3lb. of Biſcuit a Day, for a Meſs of four People, and that the Price of the firſt Barrel be to the King $2\frac{1}{4}d.$ per lb. and of the ſecond $1\frac{1}{2}d.$ ſuch was the Ship's Company, that their Meat coſt the Government 12 Guineas per Day; pray what did it pay for their Bread per Week?

60. A. ſets out from London for Lincoln, at the very ſame Time that B. at Lincoln ſets forward for London, diſtant 135 Miles; at eight Hours End they meet on the Road, and it then appeared that A. had rode $2\frac{1}{2}$ Miles an Hour more than B. at what Rate an Hour did each of them travel?

61. A. can do a Piece of Work in 10 Days, B. alone in 13; ſet them both about it together, in what Time will it be finiſhed.

62. B. and C. together can build a Boat in 18 Days; with the Aſſiſtance of A. they can do it in 11 Days; in what Time would A. do it himſelf?

63. In ſome Pariſhes in the Country, they take off 3*l.* one Year in 17 from the Rents in aſſeſſing the Farms; what will the landlord receive net out of a Farm of 140*l.* a Year, in thoſe Places, when the King's Tax is, as now, 4*s.* in the Pound?

64. A Tradeſman begins the World with 1000*l.* and finds that he can gain 1000*l.* in five Years by Land Trade alone, and that he can gain 1000*l.* in 8 Years by Sea Trade alone; and likewiſe that he ſpends 1000*l.* in $2\frac{1}{2}$ Years by Gaming; how long will his Eſtate laſt, if he follows all three?

65. If I leave Exeter at ten o'Clock on Tueſday Morning for London, and ride at the Rate of 2 Miles an Hour without Intermiſſion; you ſet out of London for Exeter at ſix the ſame Evening, and ride three Miles an Hour conſtantly: The Queſtion is, whereabout on the Road you and I ſhall meet, if the Diſtance of the two Cities be 170 Miles?

66. If the Sun moves every Day one Degree, and the Moon thirteen, and at a certain Time the Sun be at the Beginning of Cancer, and in three Days after the Moon in

in the Beginning of Aries, the Place of their next following Conjunction is required?

67. As I was beating on the Foreſt Grounds,
Up ſtarts a Hare before my two Grey-hounds:
The Dogs, being light of Foot, did fairly run,
Unto her fifteen Rods, juſt twenty-one.
The Diſtance that ſhe ſtarted up before
Was fourſcore, ſixteen Rods juſt, and no more:
Now this I'd have you unto me declare,
How far they run before they caught the Hare?

Of SOUND.

SOUND not interrupted, is by Experiments found uniformly to move about 1150 Feet in one Second of Time.

68. How long after firing the Warning Gun in Hyde Park may the ſame be heard at Highgate, taking the Diſtance at $5\frac{2}{3}$ Miles?

69. If I ſee the Flaſh of a Piece of Ordnance, fired by a Veſſel in Diſtreſs at Sea, which happens we will ſuppoſe nearly at the Inſtant of its going off, and hear the Report a Minute and three Seconds afterwards, how far is ſhe off, reckoning for the Paſſage of Sound as before?

Of the LEVERS.

There being three Orders of Levers, or three Varieties, wherein the Weights, Prop, or moving Powers, may be differently applied to the Vectis, or inflexible Bar, in order to effect Mechanical Operations in a convenient Manner.

For the Firſt Order, ſee Page 74.

Of the Second and Third Order of LEVERS.

In Mechanics, a Lever of the Second Order is, where the Power acts at one End, the Prop fixed directly at the other, and the Weight ſomewhere between them.

In this Order of Levers, their Force is in a contra Proportion to their Length.

In a Lever of the Third Order, the Prop is planted at one End

End of the Bar, the Weight at the other End, and the moving Force ſomewhere between.

70. If a Lever be 100 Inches long, what Weight, lying 7½ Inches from the End, reſting on a Pavement, may be moved with the Force of 168lb. lifting at the other End of the Lever?

71. A Water-wheel turns a Crank, working three Pump-rods, fixed juſt ſix Feet from the Joint or Pin; by which their ſeveral Levers, each nine Feet in Length, are faſtened, for the Sake of the intended Motion, at one End, the Suckers of the Pumps being worked by the other, ſhews them to be Levers of the third Order: Now I would know what the Length of the Stroke in each of the Barrels will be if the Crank be made to play juſt nine Inches round its Centre?

72. With what force ought that Water-wheel to be driven, which, circumſtanced as in the laſt Queſtion, raiſes 3 Cubic Feet of Water at every Revolution of the Wheel, each experimentally weighing 62½lb. Avoirdupoiſe, the Friction of the Machine rejected?

Motion of Bodies with their Velocities.

1. If the Quantities of Matter in any two or more Bodies put in Motion, be equal, the Forces wherewith they are moved, will be in Proportion to their Velocities.

2. If the Velocities of theſe Bodies be equal, their Forces will be directly as the Quantities of Matter contained in them.

3. If both the Quantities of Matter and the Velocities be unequal, the Forces with which the Bodies are moved, will be in a Proportion compounded of the Quantities of Matter they contain, and of the Velocities wherewith they move.

73. There are two Bodies, the one contains 25 Times the Matter of the other (or twenty-five Times heavier) but the leſſer moves with 1000 Times the Swiftneſs of the greater; in what Proportion are the Forces by which they are moved?

74. There are two Bodies, one of which weighs 100lb. the other 60lb. but the leſſer Body is impelled by a Force eight Times greater than the other, the Proportion of the

the Velocities, wherewith theſe Bodies move, is required?

75. There are two Bodies, the greater contains 8 Times the Quantity of the Matter in the leſs, and is moved with a Force 48 Times greater; the Ratio of the Velocity of theſe two Bodies is required?

1. In comparing the Motions of Bodies, if their Velocities be equal, the Spaces deſcribed by them are in direct Proportion of the Times in which they are deſcribed.
2. If the Times be equal, then the Spaces deſcribed will be as their Velocities.
3. If the Times and the Velocities be unequal, the Spaces will be in a Proportion compounded of the Times and Velocities.

76. There are two Bodies, one of which moves forty Times ſwifter than the other, but the ſwifter Body has moved but one Minute, whereas the other has been in Motion two Hours: The Ratio of the Spaces deſcribed by theſe two Bodies is required?

77. Suppoſe one Body to move thirty Times ſwifter than another; as alſo the ſwifter to move 12 Minutes, the other only 1, what Difference will there be between the Spaces by them deſcribed, ſuppoſing the laſt has moved 60 Inches?

78. There are two Bodies, one whereof has deſcribed fifty Miles, the other only 5, but the firſt hath moved with 5 Times the Velocity of the Second; what is the Ratio then of the Times they have been deſcribing thoſe Spaces?

13. RECIPROCAL PROPORTION;

OR,

The RULE of THREE INVERSE.

Reciprocal Proportion is, when of four Numbers, the Third beareth the ſame Ratio to the Firſt as the Second doth to the Fourth; therefore the leſs the Third Term is in reſpect to the Firſt, the greater will the Fourth Time be in reſpect to the Second.

RULE

RULE.

Multiply the Firſt and Second Terms together, and divide their Product by the Third Term, the Quotient will be the Anſwer.

EXAMPLES.

1. If 48 Men can perform a Piece of Work in 12 Days, how many Men can do the ſame in 72 Days?
2. How much in Length, that is four Inches broad, will make a Foot ſquare?
3. Suppoſe I lend my Friend 500*l.* for ſix Months (allowing the Month to be 30 Days), afterwards he would requite my Kindneſs by lending me 220*l.* required the Time I muſt have it, to requite my former Kindneſs?
4. A Garriſon being beſieged, has three Months Proviſions in it, at the Rate of 14 Ounces per Day each Man; but being informed that it cannot be relieved till the End of 8 Months, how many Ounces per Day muſt each Man have, that the ſaid Proviſion may laſt that Time?
5. If, when the Price of a Buſhel of Wheat is 4s. 6d. the Penny Loaf weighs 12 oz. what muſt the Penny Loaf weigh when the ſaid Buſhel is worth but 3s.?
6. Suppoſe 275 Yards of Cloth, which is 5 qrs. wide, make Coats for 130 Men; how many Yards of Shalloon, of 3 qrs. wide, will line the ſaid Coats?
7. In what Time will 600*l.* gain 50*l.* Intereſt, when 80*l.* does it in 15 Years?
8. Suppoſe 200*l.* would defray the Expences of 10 Men for 43 Weeks and 5 Days; how long would 6 Men be in ſpending the ſame Sum?
9. How many Yards of Paper, that is 3 qrs. wide, will hang a Room that is 30 Feet long and 24 Feet wide?
10. A Garriſon conſiſting of 1500 Men, being beſieged, have Proviſions only for 3 Months, but it being neceſſary they ſhould hold out 5 Months, how many Men muſt depart, that the ſaid Proviſions may ſerve that Time?

11. There is a Veſſel, having a Cock, which will empty it in 6 Hours: I demand how many Cocks of the ſame Capacity there muſt be to empty the ſaid Veſſel in 15 Minutes?

A LEVER of the FIRST ORDER.

A Lever of the Firſt Order hath the Power at one of its Ends, the Weight to be raiſed is put at the other, and the Fulcrum or Prop ſomewhere between them.

In this Order, the Power applied at one End will be reciprocally proportional to the Diſtances of thoſe Ends from the Fulcrum, or Point ſupported; or in the Steel-Yards, as the Diſtance of the Weight from the Point of Suſpenſion.

QUESTIONS for Exerciſe at Leiſure Hours.

12. What Weight will a Fellow be able to raiſe, who preſſes with the Force of a Hundred and Half on the End of an equipoiſed Hand-ſpike 100 Inches long, which is to meet with a convenient Prop exactly $7\frac{1}{2}$ Inches above the other End of the Machine?

13. What Weight, hung at 70 Inches Diſtance from the Fulcrum of a Steel-Yard, will equipoiſe a hhd. of Tobacco weighing $9\frac{1}{2}$ cwt. freely ſuſpended at 2 Inches Diſtance on the contrary Side.

MOTION of BODIES, with their VELOCITIES.

In comparing the Motion of Bodies, the Ratio or Proportion between their Velocities will be compounded of the direct Ratio of the Forces wherewith they are moved, and the reciprocal of their Quantities of Matter they contain.

14. The battering Ram of Veſpaſian weighed, ſuppoſe 100000 lb. and was moved, let us admit, with ſuch a Velocity, by Strength of Hands, as to paſs through 20 Feet in one Second of Time, and this was found ſufficient to demoliſh the Walls of Jeruſalem; with what Velocity muſt a Bullet that weighs but 30 lb. be moved, in order to do the ſame Execution?

15. A

15. A Body weighing 200lb. is impelled by ſuch a Force, as to ſend it 100 Feet in a Second; with what Velocity would a Body of 8lb. move, if it were impelled by the ſame Force?

CONTRACTIONS in the RULE of THREE.

This being conſidered, you may oftentimes perform the Work much ſhorter than by the general Rule.

1. Divide the Third Term by the Firſt, multiply that Quotient by the Second, and their Product will be the Anſwer.

EXAMPLES.

1. If four Yards of Broad Cloth coſt 3*l.* 17*s.* 6*d.* what will a Piece, containing 28 Yards, come to, at the ſame Rate?
2. If 3 Cheſts of Tea, each 3 cwt. coſt 11*l.* 13*s.* what muſt I give for 72 cwt. of the ſame?

2. Divide the Second Term by the Firſt, multiply that Quotient by the Third, and their Product will be the Anſwer.

EXAMPLES.

3. Suppoſe I give 78*l.* for 26 cwt. of Cheeſe, what muſt be given for 156 cwt. of the ſame?
4. If for 3 lb. of Tea I give 18*s.* what is the Value of 1 cwt. of the ſame?

3. Divide the Firſt Term by the Second, and divide the Third by that Quotient, which will give the Anſwer.

EXAMPLES.

5. Suppoſe I give for 6 Gowns, each containing 8 Yards of Stuff, 6*l.* what muſt be given for 64 Yards, at the ſame Rate?

6. If I give 12*s.* for 24lb. of Sugar, what muſt be given for 1½ cwt. of the ſame?

4. Divide the Firſt Term by the Third, divide the Second by that Quotient, and the laſt Quotient will be the Anſwer.

EXAMPLES.

7. Suppoſe I give for 3 Pieces of Broad Cloth, each 24 Yards, 64*l.* 14*s.* what muſt be given for eight Yards of the ſame?
8. If for 6 Parcels of Tea, each 3lb. I give 12*l.* 19*s.* what muſt I give for 6lb. of the ſame, at that Rate?

5. Divide the Firſt Term by the Third, multiply the Second by that Quotient, and the Product will be the Anſwer.

EXAMPLES.

9. How much in Length that is 3 Inches broad will make a Foot ſquare?
10. If for 48*s.* I have 225 cwt. carried 512 Miles, how many Hundred can I have carried 64 Miles for the ſame Money?

14. COMPOUND PROPORTION;

OR,

The RULE of FIVE,

Is ſo called, from its having five Numbers or Terms given to find a Sixth, which if the Proportion is direct, the Sixth Term muſt bear ſuch a Proportion to the Fourth and Fifth as the Third bears to the Firſt and Second. But if the Proportion is Inverſe, then the Sixth Term muſt bear ſuch Proportion to the Fourth and Fifth, as the Firſt bears to the Second and Third, or as the Second bears to the Firſt and Third.

The

The Three firſt Terms are a Suppoſition, the Two laſt a Demand.

RULES.

1. Let the principal Cauſe of Gain, Loſs, or Action, &c. be put in the firſt Place.
2. Let that which denotes Time, Diſtance of Place, &c. be in the ſecond Place, and the remaining one in the third Place.
3. Place the other two Terms which move the Queſtion underneath thoſe of the ſame Name.
4. If the Blank or Term ſought fall under the third Term, multiply the two firſt Terms together for a Diviſor, and the three laſt for a Dividend, the Quotient ariſing from them will be the Anſwer or ſixth Term.
5. If the Blank fall under the firſt or ſecond Term, multiply the third and fourth Terms together for a Diviſor, and the other three for a Dividend, the Quotient ariſing from them will be the Anſwer.

PROOF.

By two Statings

EXAMPLES.

1. If 6 Men can mow 72 Acres of Graſs in 12 Days, how many Men can mow 120 Acres in 4 Days?
2. Suppoſe 2 Buſhels of Wheat will be ſufficient for a Family of 6 Perſons, 12 Days, how many Buſhels will ſerve 36 Perſons 4 Days?
3. Suppoſe the Salary of 6 Perſons for 21 Weeks is 120*l.* what will be the Salary of 14 Perſons for 46 Weeks?
4. If for the Carriage of 40 cwt. 100 Miles, I give 9*l.* 5*s.* what Weight can I have carried 125 Miles for 70*l.* 10*s.* 3¼*d.* at the ſame Rate?
5. An Uſurer put out 120*l.* to receive intereſt for the ſame; but when it had continued 9 Months, he took it up, and received for the Principal and Intereſt 125*l.* 8*s.* I demand at what Rate per Cent. per Annum he received?

6. What is the Intereſt of 259*l.* 13*s.* 5*d.* for 20 Weeks, a 5*l.* per Cent. per Annum?
7. If a Quantity of Proviſions ſerve 1400 Men 20 Weeks, at the Rate of 14 Ounces per Day each Man; how many Men will the ſame Proviſions maintain for 8 Months, at the Rate of 8 Ounces per Day each?
8. Suppoſe 8 Men earn 5*l.* in 5 Days, how many Men will earn 10 Guineas in 12 Days?
9. Suppoſe 140*l.* would defray the Expences of five Men for twenty-four Weeks and four Days; how long would twelve Men be in ſpending 200*l.* at the ſame Rate?
10. What Money at 3½*l.* per Cent. per Annum, will clear 38*l.* 10*s.* in a Year and Quarter's Time?
11. If a Sack of Coals be the Allowance of 7 poor People for a Week, how many Poor belonged to that Pariſh, which, when Coals were 36*s.* per Chaldron, had 41*l.* to pay in 6 Weeks on that Account?

QUESTIONS for Exerciſe at Leiſure Hours.

12. A. and B. are on oppoſite Sides of a Wood, 134 Toiſes or Fathoms about. They begin to go round it both the ſame Way at the ſame Inſtant of Time; A. goes 11 Toiſes in 2 Minutes, and B. 17 in 3: The Queſtion is, How many Times will they ſurround this Wood, before the nimbler overtakes the ſlower?
13. If a Lever, 40 effective Inches long, will, by a certain Power thrown ſucceſſively thereon, in 13 Hours raiſe a Weight 104 Feet, in what Time will two other Levers, each 18 effective Inches long, raiſe an equal Weight 73 Feet; the Force of ſtrait Levers being in direct Proportion of their Lengths?
14. A Weight of 1½ lb. laid on the Shoulder of a Man, is no greater Burthen to him than its abſolute Weight or 24 Ounces; what Difference will he feel between the ſaid Weight applied near his Elbow, at 12 Inches from the Shoulder, and in the Palm of his Hand, 28 Inches therefrom; and how much more muſt his Muſcles then draw to ſupport it at Right Angles; that is, have his Arm extended right out?
15. In giving Directions for making an Italian Chair, the Shafts whereof were ſettled at 11 Feet between the Axle-

Axle-Tree, whereon the principal Bearing is, and the Backband, by means of which the Weight is partly thrown upon the Horſe; a Diſpute aroſe whereabout on the Shafts the Center of the Body of this Machine ſhould be fixed. The Coachmaker adviſed this to be done at 30 Inches from the Axle; others were of Opinion, that at 24 it would be a ſufficient Incumbrance to the Horſe. Now, admitting the two Paſſengers, with their Baggage, ordinarily to weigh 2 cwt. a piece, and the Body of the Vehicle to be about 70lb. more; pray what will the Beaſt, in both thoſe Caſes, be made to bear more than his Harneſs?

16. Suppoſe a Perſon to travel 152 Miles in 7 Days, when the Days are 12 Hours long; how many Days will he be in travelling 576 Miles, when the Days are 16 Hours long?

17. My Water-Tub holds 147 Gallons: the Pipe uſually brings in 14 Gallons in 9 Minutes; the Tap diſcharges, at a Medium, 40 Gallons in 31 Minutes. Suppoſing theſe both careleſsly to be left open, and the Water to be turned at 2 in the Morning; the Servant at 5, finding the Water running, ſhuts the Tap, and is ſolicitous in what Time the Tub will be filled after this Accident, in caſe the Water continues flowing from the Main.

18. If the Scavenger's Rate at $1\frac{1}{2}d.$ in the Pound, comes to $6s.\ 7\frac{1}{2}d.$ where they ordinarily aſſeſs $\frac{4}{5}$ of the Rent; what will the King's Tax for that Houſe be, at $4s.$ in the Pound, rated at the full Rent?

14. If when Port Wine is 17 Guineas the Hogſhead, a Company of 45 People will ſpend $20l.$ therein, in a certain Time; what is Wine a Pipe, when 13 Perſons more will ſpend $63l.$ in Twice the Time, drinking with equal Moderation?

20. There is an Iſland 73 Miles round, and three Footmen all ſtart together, to travel the ſame Way about it; A. travels 5 Miles a Day, B. 8, and C. 10; when will they all come together again?

21. A certain Man hires a Labourer on this Condition, that for every Day he worked he ſhould receive $1s.$ but for every Day he was idle he ſhould be mulcted $8d.$ when 390 Days were paſt, neither of them were indebted to one another; how many Days did he work, and how many Days was he idle?

22. A

22. A. lent his Friend B. fourſcore and eleven Guineas, from the 11th of December to the 10th of May following; B. on another Occaſion let A. have 100 Marks, from September the 3d to Chriſtmas following: Quere, How long ought the Perſon obliged to let his Friend uſe 40*l.* fully to retaliate the Favour?

23. A Man hired a Labourer for 40 Days, on Condition that he ſhould have 20*d.* for every Day he worked, and forfeit 10*d.* for every Day he idled; at laſt he received 2*l.* 1*s.* 8*d.* for his Labour; how many Days did he work, and how many was he idle?

15. PRACTICE.

So called from the General Uſe it is to all Perſons concerned in Trade and Buſineſs.

All Queſtions in the Rule of Three, where the firſt Term is Unity or one, may be performed by this Rule.

Which is by taking aliquot or even Parts, by which Means many tedious Reductions may be avoided.

But as there are a great Variety of ſuch Parts, ſo many, therefore, are the Ways of applying them, that it would be an endleſs Taſk to give all the eaſy Methods of Operation adapted to particular Caſes; ſo I ſhall only give the General Rules, with a ſufficient Number of Examples to each.

In order to perform this Rule expeditiouſly, it will be neceſſary that the Learner gets by Heart the following

TABLES.

Of a Pound.	*Of a Sh.*	*Of a Ton.*	*Of an Hund.*	*Of a Quar. of an C.*
s. d.	*d.*	*cwt.*	*qr. lb.*	*lb.*
1 8 = $\frac{1}{12}$	1 = $\frac{1}{12}$	2 = $\frac{1}{10}$	1 or 28 = $\frac{1}{4}$	$3\frac{1}{2}$ = $\frac{1}{8}$
2 0 = $\frac{1}{10}$	$1\frac{1}{2}$ = $\frac{1}{8}$	$2\frac{1}{2}$ = $\frac{1}{8}$	2 or 56 = $\frac{1}{2}$	4 = $\frac{1}{7}$
2 6 = $\frac{1}{8}$	2 = $\frac{1}{6}$	4 = $\frac{1}{5}$	0 16 = $\frac{1}{7}$	7 = $\frac{1}{4}$
3 4 = $\frac{1}{6}$	3 = $\frac{1}{4}$	5 = $\frac{1}{4}$	0 14 = $\frac{1}{8}$	14 = $\frac{1}{2}$
4 0 = $\frac{1}{5}$	4 = $\frac{1}{3}$	10 = $\frac{1}{2}$		
5 0 = $\frac{1}{4}$	6 = $\frac{1}{2}$			
6 8 = $\frac{1}{3}$				
10 0 = $\frac{1}{2}$				

1. When

1. When the Price is leſs than a Penny.

RULE.

Divide by the aliquot Parts that are in a Penny, then by 12 and 20, which will give the Anſwer.

EXAMPLES.

1. 2107 at $\frac{1}{4}d.$ 2. 1470 at $\frac{1}{2}d.$ 3. 1276 yds. at $\frac{3}{4}d.$ per yd.

2. When the Price is leſs than a Shilling.

RULE.

Take the aliquot Part or Parts that are in a Shilling, add them together, and the Sum will be the Anſwer in Shillings, &c. which, divided by 20 as before, will give £. &c.

EXAMPLES.

4. 1762 at 1*d.* 5. 1400 at $1\frac{1}{4}d.$ 6. 2462 at $1\frac{1}{2}d.$ per lb.

7. 1041 at $1\frac{3}{4}d.$ 8. 2490 at 2*d.* 9. 2408 at $2\frac{1}{4}d.$

10. 640 at $2\frac{1}{2}d.$ 11. 1740 at $2\frac{3}{4}d.$ 12. 746 at 3*d.*

13. 1417 at $3\frac{1}{4}d.$ 14. 3091 at $3\frac{1}{2}d.$ 15. 214 at $3\frac{3}{4}d.$

16. 2000 at 4*d.* 17. 569 at $4\frac{1}{4}d.$ 18. 1246 at $4\frac{1}{2}d.$

19. 1426 at $4\frac{3}{4}d.$ 20. 2740 at 5*d.* 21. 2147 at $5\frac{1}{4}d.$

22. 674 at $5\frac{1}{2}d.$ 23. 1746 at $5\frac{3}{4}d.$ 24. 1741 at 6*d.*

25. 2142 at $6\frac{1}{4}d.$ 26. 1040 at $6\frac{1}{2}d.$ 27. 1746 at $6\frac{3}{4}d.$

28. 1000 at 7*d.* 29. 1656 at $7\frac{1}{4}d.$ 30. 1420 at $7\frac{1}{2}d.$

31. 674 at $7\frac{3}{4}d.$ 32. 2170 at 8*d.* 33. 1700 at $8\frac{1}{4}a.$

34. 1765

34. 1765 at $8\frac{1}{2}d.$ 35. 749 at $8\frac{3}{4}d.$ 36. 1417 at $9d.$

37. 2373 at $9\frac{1}{4}d.$ 38. 1476 at $9\frac{1}{2}d.$ 39. 1760 at $9\frac{3}{4}d.$

40. 6000 at $10d.$ 41. 4652 at $10\frac{1}{4}d.$ 42. 2476 at $10\frac{1}{2}d.$

43. 2176 at $10\frac{3}{4}d.$ 44. 1276 at $11d.$ 45. 2142 at $11\frac{1}{4}d.$

46. 4760 at $11\frac{1}{2}d.$ 47. 640 at $11\frac{3}{4}d.$

3. When the Price is more than a Shilling, but leſs than two.

RULE.

Take the Part or Parts, with ſo much of the given Price, as is more than a Shilling, (as in the laſt Rule,) which add to the given Quantity, and the Sum will be the Anſwer in Shillings, &c. which divided by 20, will give £.

Note.—The Method of performing this Caſe, being ſo little different from the laſt, I ſhall only give a few Examples, which by proper Inſtructions from the Tutor will ſuffice.

EXAMPLES.

48. 1074lb. at 1*s.* $10\frac{3}{4}d.$ 49. 2140 at 1*s.* $\frac{1}{4}d.$ per Ounce.

50. 1749 at 1*s.* $11\frac{1}{2}d.$ 51. 2140 at 1*s.* $5d.$

52. 1453 at 1*s.* $7\frac{1}{2}d.$ 53. 1614 at 1*s.* $10d.$

54. 2647 at 1*s.* $11\frac{3}{4}d.$

4. When the Price conſiſts of any even Number of Shillings, under 20.

RULE.

Multiply the given Quantity by Half the Price, doubling the firſt Figure of the Product for Shillings, and the Reſt of the Product will be £.

EXAMPLES.

EXAMPLES.

55. 2476 at 2*s*. 56. 1476 at 4*s*. 57. 276lb. at 6*s*. per lb.

58. 2100 at 8*s*. 59. 274 at 10*s*. 60. 674 at 12*s*.

61. 2680 at 14*s*. 62. 267 at 16*s*. 63. 1267 at 18*s*.

5. When the Price is any odd Number of Shillings under 20.

RULE.

Multiply the given Quantity by the Price, and the Product will be the Anſwer in Shillings, which divided by 20 will give £.

EXAMPLES.

64. 2174 at 7*s*. 65. 1427 at 9*s*. 66. 647 at 11*s*.

67. 267 at 13*s*. 68. 274 at 17*s*. 69. 1260 at 19*s*.

6. When the Price is Shillings, or Shillings and Pence, and they an aliquot Part of a Pound.

RULE.

Divide by the aliquot Part, and the Quotient will be the Anſwer.

EXAMPLES.

70. 2420 at 4*s*. 71. 1764 at 5*s*. 72. 4762 at 1*s*. 8*d*. per yd.

73. 467 at 2*s*. 6*d*. 74. 1760 at 3*s*. 4*d*. 75. 176 at 6*s*. 8*d*.

7. When the Price is Shillings, Pence, and the Shillings and Pence be not an aliquot Part of a Pound.

RULE.

RULE.

Multiply the given Quantity by the Shillings, and take Parts for the Pence, &c. add them together, and the Sum will be the Anſwer in Shillings, which, divided by 20, will give £.

EXAMPLES.

76. 1420 at 3*s.* 3*d.*

77. 427 at 5*s.* 9*d.* per Yard.

78. 402 at 10*s.* 8¾*d.*

79. 174 at 17*s.* 9½*d.*

80. 273 at 19*s.* 4¾*d.*

81. 260 at 14*s.* 11¾*d.*

8. When the Price is Pounds only.

RULE.

Multiply the given Quantity by the Price, and the Product will be the Anſwer.

EXAMPLES.

82. 120 at 4*l.*

83. 96 at 17*l.* per cwt.

84. 100 at 3*l.*

85. 142 at 42*l.*

9. When the Price is Pounds and Shillings.

RULE.

Multiply the Quantity given by the Pounds, as in the laſt Caſe, and proceed with the Shillings; if they are even, as in Caſe IV. but if odd, take aliquot Parts, add them together, the Sum will be the Anſwer; or reduce the given Price to Shillings, by which multiply the given Quantity, and divide by 20, will give the Anſwer.

EXAMPLES.

86. 649 at 2*l.* 6*s.*

87. 526 at 7*l.* 16*s.*

88. 142 at 1*l.* 17*s.*

89. 164

89. 164 at 24*l.* 19*s.* 90. 271 at 5*l.* 7*s.* 91. 604 at 20*l.* 9*s.*

92. 914 at 10*l.* 15*s.* 93. 737 at 1*l.* 14*s.*

10. When the Price is Pounds, Shillings, and Pence, and the Shillings and Pence be an aliquot Part of a Pound.

RULE.

Multiply the given Quantity by the Pounds, as in the laſt Rule; and take Parts for the Shillings and Pence, as in Caſe VI. add them together, and the Sum will be the Anſwer.

EXAMPLES.

94. 274 at 7*l.* 6*s.* 8*d.* 95. 120 at 12*l.* 3*s.* 4*d.*

96. 97 at 9*l.* 1*s.* 8*d.* 97. 512 at 42*l.* 5*s.*

11. When the Price is Pounds, Shillings, Pence, and Farthings, and the Shillings and Pence be not an aliquot Part of a Pound.

RULE.

Reduce the Pounds and Shillings into Shillings, multiply the given Quantity by the Shillings, as in Caſe IX. take Parts for the Pence and Farthings, as in Caſe II.

Note.—When the given Quantity doth not exceed 100, proceed as in Sect. 9.

EXAMPLES.

98. 1472 at 4*l.* 6*s.* 7¼*d.* 99. 279 at 6*l.* 11*s.* 9¾*d.*

100. 1420 at 19*l.* 14*s.* 11½*d.* 101. 2074 at 1*l.* 17*s.* 5½*d.*

102. 27 at 4*l.* 11*s.* 8¾*d.* 103. 64 at 12*l.* 13*s.* 7¼*d.*

12. When the Price and Quantity given are of ſeveral Denominations.

RULE.

Multiply the Price of one, by the Quantity given, and take Parts for Quarters, Pounds, &c. add them together, and the Sum will be the Anſwer.

EXAMPLES. Ans 131

104. Bought 7 cwt. 3 qrs. 18 lb. of Sugar, at 17*s.* 6*d.* per cwt. what comes it to?

105. Sold 420 oz. 15 dwts. 16 grs. of Gold, at 3*l.* 16*s.* 10½*d.* per Ounce, &c.

106. Bought Tobacco at 3*l.* 17*s.* 4½*d.* per cwt. what is the Worth of 72 cwt. 3 qrs. 19 lb.?

107. Bought 12 cwt. 1 qr. 17 lb. of Hops, at 4*l.* 4*s.* 4*d.* per cwt. what do they ſtand me in?

108. Sold 23 cwt. 18 lb. of Sugar, at 4*l.* 14*s.* 1½*d.* per cwt. what comes it to?

109. What is the Rent of 476 Acres, 3 Roods, 28 Perches, at 3*l.* 7*s.* 11*d.* per Acre?

110. Sold 16 cwt. 2 qrs. of Tallow, at 2*l.* 6*s.* 11*d.* per cwt. what comes it to?

111. Sold 48 cwt. 2 qrs. 7 lb. of fine Hyſon Tea, at 74*l.* 16*s.* 6*d.* per cwt. what muſt I receive for the ſame?

112. What is the Value of 24 lb. of double-refined Sugar, at 4*l.* 17*s.* per cwt.?

113. What is the Value of 17 lb. of Malaga Raiſins, at 3*l.* 5*s.* 4*d.* per cwt.?

When the Pupil is perfect in all the Rules to the foregoing Caſes, he may then be taught the Contractions.

EXAMPLES.

1. 1276 at ¼*d.* 2. 1740 at 2¼*d.* 3. 1420 at 7½*d.*

4. 3162 at 1*s.* 7*d.* 5. 427 at 5*s.* 9*d.* 6. 246 at 17*s.* 10*d.*

7. 241 at 6*l.* 19*s.* 8. 641 at 1*l.* 15*s.*

16. TARE and TRETT.

In this Rule there are ſix Things to be obſerved, viz.

1. The

1. The Groſs Weight. 2. Tare. 3. Trett. 4. Suttle. 5. Cloff. 6. Net Weight.

1. The Groſs Weight is the whole Weight of the Goods, and that which they are packed up in.
2. Tare is an Allowance made to the Purchaſer for the Weight of the Box, Bag, Barrel, or whatever contains the Goods bought, and is either
   At ſo much in the Whole Groſs Weight;
   At ſo much per Box, Bag, &c.;—or,
   At ſo much per Cent.
3. Trett is an Abatement of 4 lb. per 104 lb. and is the twenty-ſixth Part allowed for Waſte, Duſt, &c. made by the Merchant to the Buyer.
4. Suttle is when the Tare is deducted from the Groſs.
5. Cloff is an Allowance of 2 lb. to the Citizens of London on every Draught above 3 cwt. on ſome Sorts of Goods, as Beaver, Galls, Madder, Argol, &c.
6. Net Weight is when all Allowance is deducted from the Groſs.

1. When the Tare is at ſo much in the Groſs Weight, to find the Net.

RULE.

Subtract the Tare from the Groſs, and the Remainder is the Net Weight.

EXAMPLES.

1. What is the Net Weight of 24 Hogſheads of Tobacco, each weighing 6 cwt. 2 qrs. 17 lb. Groſs? Tare in the whole 17 cwt. 3 qrs. 27 lb.
2. What is the Net Weight of 5 hhds. of Sugar, weighing as follows, viz.

	cwt.	*qrs.*	*lb.*		*qrs.*	*lb.*
No. 1.	4	2	14	Tare	0	21
2.	3	0	17		0	18
3.	5	3	10		1	11
4.	6	1	16		0	27
5.	3	2	18		0	19
Groſs						
Tare						
Net						

2. When

2. When Tare is at ſo much per Box, Bag, &c. to find the Net Weight.

R U L E.

Multiply the Tare of each Box, Bag, &c. by the Number of Boxes, &c. the Product ſubtract from the Groſs as before, and the Remainder will be the Net Weight.

E X A M P L E S.

3. What is the Net Weight of 8 Frails of Raiſins, each weighing 2 cwt. 3 qrs. Groſs, Tare at 22 lb. per Frail?
4. What is the Net Weight of 40 Bales of Silk, each weighing 3 cwt. 27 lb. Groſs, Tare at 18 lb. per Bale?

3. When Tare is at ſo much per cwt. to find the Net Weight.

R U L E.

Divide the whole Groſs by the ſaid Part or Parts, that the Tare is of a cwt. and the Quotient thence ariſing will be the Tare, which ſubtracted from the Groſs, as before, will give the Net Weight.

E X A M P L E S.

5. What is the Net Weight of 22 Barrels of Figs, each 2 cwt. 1 qr. 17 lb. Groſs, Tare at 14 lb. per cwt.?
6. What is the Net Weight of 9 hhds. of Sugar, each weighing 6 cwt. 2 qrs. 12 lb. Groſs, Tare at 17 lb. per cwt.?

4. When Trett is allowed with the Tare, to find the Net Weight.

R U L E.

Find the Tare as before, and ſubtract it from the Groſs, the Remainder will be the Suttle, which divide by 26, and the Quotient will be the Trett, which ſubtract from the Suttle, the Remainder will be the Net Weight.

EXAMPLES.

EXAMPLES.

7. What is the Net Weight of 16 cwt. 3 qrs. Groſs, Tare 1 cwt. 1 qr. 12 lb. and Trett 4 lb. per 104?
8. In 27 Bags of Coffee, each weighing Groſs, 2 cwt. 3 qrs. 27 lb. Tare 13 lb. per 112 lb. and Trett 4 lb. per 104 lb. what is the Net Weight?

5. When Cloff is allowed, to find the Net Weight.

RULE.

Divide the whole Groſs, by 168, 2 lb. being 168th Part of 3 cwt. or 336 lb. or you may divide the Number of cwts. by 3, which brings them into 3 cwts. then 2 lb. being allowed for every 3 cwt. ſo as many 3 cwts. as it produces, ſo many 2 lb. it will allow, which divided by 56, (the double Pounds in a cwt.) the Quotient will be the Hundreds, and the Remainder will be ſo many 2 lb. to which adding what may be allowed for the odd cwts. qrs. and lb. of the given Weight, will make the whole Cloff, which ſubtract from the Groſs will be the Net Weight.

EXAMPLES.

9. What will be the Net Weight of 5647 cwt. 3 qrs. 13 lb. Groſs, allowing for Cloff 2 lb. for every 3 cwt.?
10. What is the Net Weight of 14 Barrels of Spices, weighing altogether 42 cwt. 3 qrs. Groſs, allowing for Cloff 2 lb. per 3 cwt.?

6. When Tare, Trett, and Cloff, be allowed with any Quantity (Groſs) to find the Net Weight.

RULE.

For the Tare and Trett, proceed as in Caſe IV. and the Remainder, which was called the Net there, will be the Suttle here, which to find the Cloff of, proceed as in the laſt Caſe.

EXAMPLES.

11. What is the Net Weight of 15 cwt. 3 qrs. 2 lb. Groſs,

allowing for Tare 7 lb. per cwt. Trett 4 lb. per 104 lb. and Cloff 2 lb. for 3 cwt.?

12. What is the Net Weight of 4 hhds. of Sugar, weighing as follows, viz.

	cwt.	*qrs.*	*lb.*	
No. 1.	4	2	17	Tare 8 lb. per cwt. Trett 4 lb. per 104 lb. Cloff 2 lb. per 3 cwt.
2.	5	3	14	
3.	3	2	26	
4.	6	2	12	

QUESTIONS for EXERCISE.

13. The Net Proceeds of a Hogſhead of Barbadoes Sugar, were 4*l.* 14*s.* 6*d.* the Cuſtom and Fees 2*l.* 8*s.* 6*d.* Freight 22*s.* 8*d.* Factorage 4*s.* 9*d.* The Groſs Weight was 9 cwt. 3 qrs. 10 lb. Tare 1 lb. in 10: Pray then how was the Sugar rated in the Bill of Parcels?

14. I have imported 80 Jars of Lucca Oil, each containing 1180 ſolid Inches: What came the Freight to, at 4*s.* 6*d.* per cwt. Tare 1 lb. in 10, counting 7¼ lb. of Oil to the Wine Gallon of 231 cubic Inches?

17. SIMPLE INTEREST

Is that which ariſes only from the Principal, and is a Profit allowed by the Borrower to the Lender, for the Loan or Forbearance of any Sum of Money, for ſome determined Space of Time, and at any Rate (per Cent. per Annum) agreed upon; which according to Law muſt not exceed 5*l.* for the Uſe or Intereſt of 100*l.* Principal, called Cent. for 12 Months, called Annum.

The Amount is the Principal and Intereſt added together.

Note.—The Rules for Simple Intereſt, ſerve alſo for calculating Factorage, Brokerage, Inſurance, purchaſing of Stocks, or any Thing elſe, that is rated at ſo much per Cent.

To find the Intereſt of any Sum of Money, for any Number of Years.

RULE.

RULE.

Multiply the Principal by the Rate per Cent. that Product divided by 100, will give the Interest for a Year, which multiplied by the Number of Years given, and the Product will be the Answer. Or, by taking the aliquot Part or Parts with the given Rate that are in 100*l.*

EXAMPLES.

1. What is the Interest of 824*l.* 18*s.* 2*d.* for a Year, at four per Cent. per Annum?
2. What is the Interest of 500*l.* for 4 Years, at 4½ per Cent. per Annum?
3. What is the Amount of 264*l.* 4*d.* for 12 Years, at 5 per Cent. per Annum?

When the Rate per Cent. is ¼, ½, or ¾, more than the Pounds given in the said Rate.

RULE.

Multiply the Principal by the Pounds in the Rate per Cent. then take Parts for ¼, ½, or ¾, from the Principal, which add to the Product, and the Sum divide by 100, as before.

EXAMPLES.

4. What is the Interest of 246*l.* 18*s.* for a Year, at 4¼ per Cent. per Annum?
5. What is the Interest of 140*l.* 10*s.* for 7 Years, at 4½ per Cent. per Annum?
6. What is the Amount of 470*l.* for 5 Years, at 3¾ per Cent. per Annum?

COMMISSION

Is an Allowance from a Merchant to his Factor, or Correspondent abroad, in buying and selling of Goods, and is at a certain Rate per Cent. according to the Custom of the Country, where the Factor resides.

This, as well as Brokerage and Insurance, is computed in the same Manner as for even Pounds, and for ¼, ½, or ¾, as in the last Case.

EXAMPLES.

EXAMPLES.

7. My Factor writes me Word, that he has bought Goods, upon my Account, to the Value of 474*l.* 14*s.* 6*d.* I demand to know what his Commiſſion comes to, at $3\frac{1}{4}$*l.* per Cent.?
8. Suppoſe I allow my Correſpondent $2\frac{1}{2}$ per Cent. for his Commiſſion; what is his Demand on the Diſburſement of 742*l.* 12*s.* 6*d.*?

BROKERAGE

Is an Allowance or Fee paid unto a Perſon called a Broker, for aſſiſting others in buying or diſpoſing of their Goods, and in the City of London they are not to act without a Licence from the Lord Mayor.

3. To find the Brokerage for any Sum, at any Rate under 1*l.* per Cent.

RULE.

Divide the given Sum by 100, and it will give the Intereſt at 1*l.* per Cent. which Intereſt you muſt take Parts from, with the Rate per Cent. and add them together, the Sum will be the Brokerage required.

EXAMPLES.

9. What is the Brokerage of 420*l.* 12*s.* 6*d.* at 6*s.* 4*d.* per Cent.?
10. Suppoſe I employ a Broker, who ſells Goods for me, to the Value of 1000*l.* what may he demand for Brokerage, it being at 4*s.* 6*d.* per Cent.?
11. Suppoſe a Broker diſpoſes of Goods for me, to the Amount of 540*l.* 10*s.* what comes the Brokerage to, at 13*s.* 10*d.* per Cent.?
12. What is the Brokerage of 2474*l.* 15*s.* at 19*s.* $9\frac{1}{2}$*d.* per Cent.?

INSURANCE

Is a Contract or Agreement whereby one or more Perſons, called Inſurers, &c. oblige themſelves to anſwer for the

the Loſs or Damage of Ships, Houſes, Goods, &c. by Storms, Fires, &c. in Conſideration of a Premium, paid by the Proprietors of the Thing injured.

To find the Inſurance of any Sum, at any Rate under 1*l.* proceed as in the laſt Caſe; if above, as in Caſe I.

EXAMPLES.

13. Suppoſe I inſure for 1460*l.* at 2*s.* 6*d.* per Cent. per Annum, what doth the Inſurance come to?
14. What is the Inſurance of 2460*l.* at 10*l.* 15*s.* per Cent.?
15. Shipped at Jamaica, Goods to the Value of 2500*l.* upon which I made an Inſurance at 6½*l.* per Cent. what does it come to?
16. What is the Inſurance of an Eaſt India Ship and Cargo, valued at 7406*l.* 17*s.* 6*d.* at 15¾*d.* per Cent.?

PURCHASING of STOCKS.

Stocks are the public Funds of the Nation, the Shares of which being transferable from one Perſon to another, occaſions that extenſive Buſineſs called Stock Jobbing.

RULE.

Multiply the Sum to be purchaſed, by the Exceſs of the Rate per Cent. above 100, the Product divide by 100, as before, and the Quotient added to the given Sum, will give the required Purchaſe.

If under Par, i. e. if under 100 per Cent. proceed as in Caſe II.

EXAMPLES.

17. What is the Purchaſe of 400*l.* South Sea Stock, at 120*l.* 5*s.* per Cent.?
18. What is the Purchaſe of 470*l.* Bank Stock, at 87½ per Cent.?
19. What is the Purchaſe of 2470*l.* 17*s.* 10*d.* Bank Annuities, at 103½ per Cent.?
20. What is the Purchaſe of 876*l.* India Stock, at 114⅝ per Cent.?

4. When

4. When the Intereſt is for $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of a Year, or any Number of Years beſides.

RULE.

Find the Intereſt for the Years, as in Caſe I. then for $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$, take Parts from the Intereſt of 1 Year, i. e. for $\frac{1}{4}$, take one-fourth Part of the ſaid Intereſt, for $\frac{1}{2}$, take one-half, and for $\frac{3}{4}$, take the Parts compounded of $\frac{1}{2}$, that is, a half for $\frac{3}{4}$, then half of that half for $\frac{1}{4}$, which added to the Intereſt for Years (if any) the Sum will be the Intereſt required.

EXAMPLES.

21. What is the Intereſt of 427*l.* 10*s.* for four Months, at 4 per Cent. per Annum?
22. What is the Intereſt of 246*l.* 12*s.* 6*d.* for $1\frac{1}{4}$ Year, at 5 per Cent. per Annum?
23. Lent 209*l.* 18*s.* upon a Mortgage, to receive Intereſt for the ſame, at $4\frac{1}{2}$ per Cent. per Annum, till it was paid off, which was not till the end of $4\frac{1}{2}$ Years after; now I ſhould be glad to know what's due to me?
24. A Gentleman dying left his Daughter 604*l.* 17*s.* 6*d.* for her Fortune, to be paid her, when at Age, with Intereſt, at $5\frac{1}{2}$ per Cent. per Annum. Now ſhe came to Age in 3 Years 9 Months after her Father's Death: What is the Amount of her Fortune, that is, what is ſhe to receive in all, Principal and Intereſt?

5. When the Intereſt required is for any Number of Weeks.

RULES.

1. Find the Intereſt of the given Sum for a Year, as in Caſe I.

2. Say, as 52 Weeks : are to that Intereſt of the given Sum : : ſo are the Weeks given : to the Intereſt required. Or you may divide the given Weeks into aliquot Parts of a Year, or 52 Weeks.

EXAMPLES.

EXAMPLES.

25. What is the Intereſt of 400*l.* 15*s.* for 4 Weeks at 4 per Cent. per Annum?
26. What is the Amount of 600*l.* for 26 Weeks, at $3\frac{1}{4}$ per Cent. per Annum?
27. What is the Intereſt of 740*l.* for 4 Years and 42 Weeks, at 5 per Cent. per Annum?
28. What is the Amount of 200*l.* for 5 Years and 50 Weeks, at $4\frac{1}{2}$ per Cent. per Annum?

6. To find the Intereſt of any Sum, for any Number of Days.

RULES.

1. Say as 365 Days : are to the Intereſt of the given Sum for a Year : : ſo are the Days given : to the Intereſt required.

2. (When convenient) divide the Days into aliquot Parts of a Year, or 365.

3. Reduce the Principal into Pence, which multiply by the Number of Days, and that Product by the Rate per Cent. for a Dividend, then multiply 365 (the Days in a Year) by 100 for a Diviſor, by which divide the Dividend, and the Quotient will be the Anſwer in Pence, which bring to Pounds.

4. Multiply the given Sum by the Number of Days, and divide the Product by 7300 (viz. $\frac{100 \times 365}{5}$) the Quotient will give the Intereſt at 5 per Cent. and for a higher or lower Rate, take aliquot Parts for a Difference, which add or ſubtract accordingly.

A TABLE

A TABLE of Days for any given Time leſs than a Year.

DAYS.	JANUARY.	FEBRUARY.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29	60	88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

The

The USE of the TABLE.

First, To know the Number of Days from the Beginning of the Year to any given Day of any Month.

This is obtained by Inspection only; thus, from January the 1st, to August the 8th, is 220 Days; to November the 24th is 328 Days, &c.

Secondly, To know what is the Number of Days from any given Day of any Month, to the end of the Year.

Suppose August 8th, then from —	365 Days,
Subtract the Number answering to August 8,	220
There remains the Number of Days, viz.	145

Thirdly, To find the Number of Days between the given Day of any Month, and the given Day of any other Month, in the same Year.

For Instance, To know how many Days there are between May the 9th, and November the 5th.

Thus, from the Number answering to Nov. 5,	309 Days,
Subtract that answering to May 9,	129
The Remainder is the Number of Days sought viz. — —	180

Fourthly, To find the Number of Days from any given Day of any Month in one Year, to any given Day of any Month in the next Year.

How many Days is it from October the 12th in one Year, to June the 10th in the next?

Thus, from the Days of a whole Year,	365 Days,
Subtract the Number answering to Oct. 12, viz.	285
Remains the Number to the End of the Year,	80
To which add the Number to June 10,	161
The Sum is the Number of Days required, viz.	241

And thus is the Number of Days readily found for any Interval of Time given, in the same Year completely; or which is Part of one, or Part of another Year.

EXAMPLES.

29. What is the Intereſt of 200*l.* for 73 Days, at $3\frac{1}{2}$ per Cent. per Annum?
30. What is the Amount of 340*l.* 10*s.* from January 1, 1779, to July 18 following, at 5 per Cent. per Ann.?
31. What is the Intereſt of 500*l.* from December 4, 1779, to March 10, 1781, at 4 per Cent. per Annum?

When the Amount, Time, and Rate per Cent. are given, to find the Principal.

RULES.

7. 1. Say, as the Amount of 100*l.* at the Rate and Time given : is to 100*l.* : : ſo is the Amount given : to the Principal required. Or,

2. The Examples in this and the two following Caſes may be ſolved by the Rule in Sect. XV.

EXAMPLES.

32. What Principal, being put to Intereſt for $9\frac{1}{2}$ Years, at $4\frac{1}{2}$ per Cent. per Annum, will amount to 856*l.* 10*s.*
33. What Principal, being put out to Intereſt for $7\frac{1}{4}$ Years, will amount to 614*l.* 3*s.* 11*d.* at 3 per Cent. per Ann.?

8. When the Principal, Rate per Cent. and the Amount are given, to find the Time.

RULE.

Say, as the Intereſt of the Principal for a Year : is to 1 Year : : ſo is the whole Intereſt : to the Time required.

EXAMPLES.

34. In what Time will 600*l.* amount to 856*l.* 10*s.* at $4\frac{1}{2}$ per Cent. per Annum?
35. In what Time will 496*l.* 6*s.* 8*d.* amount to 614*l.* 3*s.* 11*d.* at 3 per Cent. per Annum?

9. When the Principal, Amount, and Time, are given, to find the Rate per Cent.

RULES.

RULES.

1. Say, as the Principal : is to the Intereſt, for the whole Time : : ſo is 100*l.* to the Intereſt for the ſame Time.

2. Divide that Intereſt by the given Time, and the Quotient will be the Rate per Cent. required.

EXAMPLES.

36. At what Rate per Cent. per Annum, will 600*l.* amount to 856*l.* 10*s.* in 9½ Years?

37. At what Rate per Cent. per Annum, will 498*l.* 6*s.* 8*d.* amount to 614*l.* 3*s.* 11*d.* in 7¾ Yea rs?

QUESTIONS for Exerciſe in the Eight laſt CASES, at Leiſure Hours.

38. Lent at Chriſtmas 1771, the Sum of 5000*l.* at 4½ per Cent. after which Time I lent ſeveral Sums at the ſame Rate, and drew upon the Borrower, as Buſineſs required; viz. on Lady-day 1772, I drew for 185 Guineas; on Midſummer-day following, I lent 500 Moidores, and drew for 700*l.* and on Michaelmas-day, in the ſame Year, I lent 569*l.* 17*s.* I demand what Caſh the Borrower owed me at that Time?

39. On the firſt of May 1779, I lent Ralph Newlands, per Bill at one Day's Date, 500*l.* which I received back in the following partial Payments; viz. on the 13th of May 50*l.* on the 4th of June 56*l.* on the 14th of July 44*l.* on the 23d ditto 50*l.* on the 18th of Auguſt 87*l.* on the 30th ditto 13*l.* on the 21ſt of September 30*l.* on the 18th of October 30*l.* on the 29th ditto 40*l.* on the 11th of November 50*l.* and on the 28th of December 50*l.* Now I demand to know what Intereſt is due at 5 per Cent. per Annum?

40. Lent to John Jameſon, per Bill, dated 18th of Jan. 1784, payable one Day after Date, 878*l.* 19*s.* 10*d.* which I received back in the following partial Payments; viz. on the 27th of February 57*l.* 15*s.* 7*d.* on the 18th of March 37*l.* 14*s.* on the 29th of April 34*l.* 11*s.* on the 12th of May 136*l.* 15*s.* 7*d.* on the 19th of June 67*l.* 13*s.* 4*d.* on the 15th of July 15 Guineas and 6*d.* on the 25th ditto 111*l.* 11*s.* 11*d.* on the 3d of October

78*l.* 7*s.* 4*d.* on the 19th of November 100*l.* on the 23d ditto 100*l.* and on the 30th of December received the Balance of the Principal: How much Intereſt ought I to claim at 5 per Cent.?

41. Lent 109 Guineas at 4 per Cent. by the 18th of Auguſt 1784, was raiſed by the Intereſt to ſo many Moidores; abating Half a Crown, pray on what Day did the Bond bear Date?

42. If 100*l.* in 12 Years be allowed to gain 39*l.* 19*s.* 8*d.* in what Time will any other Sum double itſelf at the ſame Rate of Intereſt?

43. A Bond was made on the 7th of Auguſt 1773, at 6 per Cent. per Annum, for 1114*l.* 10*s.* on the 11th of May, 1776, 140*l.* was paid off, and a freſh Bond entered into for the Remainder, at 5½ per Cent. per Annum, at the Time the Intereſt for this laſt was 21*l.* 16*s.* 8*d.* there was paid off 87*l.* 11*s.* 9*d.* The old Bond being then taken up, a new one was given for the Reſidue, which being paid off September 11, 1784, the Bond-owner took no more than 1409*l.* 16*s.* 8*d.* in full Payment: at what Rate did he take Intereſt per Cent. per Annum, upon the laſt Renewal of the Bond?

44. It is propoſed by an elderly Perſon in Trade, deſirous of a little Reſpite, to admit a ſober induſtrious young Fellow in the Buſineſs; and to encourage him, offers, that if his Circumſtances will allow him to advance 100*l.* his Pay ſhall be 40*l.* a Year; if he ſhall be able to put 200*l.* into the Stock, he ſhall have 55*l.* a Year, and if 300*l.* he ſhall receive 70*l.* annually. In this Propoſal, what was allowed for his Attendance ſimply? and what Rate per Cent. was allowed for his Money?

45. June 23d, 1745, bought 900*l.* of New South Sea Annuities, at 111⅛ per Cent. viz. The Day before the cloſing the Books, the Brokerage whereof is always 2*s.* 6*d.* per Cent. on the Capital, whether you buy or ſell: The Midſummer Dividend 2 per Cent. became due and payable on the 10th of Auguſt following; by which Time the Rebellion growing conſiderable in the North, the ſaid Annuities were down at 92¾ per Cent. In the general Alarm, ſold 400*l.* Capital at that Price; but continued the Remainder, till a ſecond, third, fourth, and fifth Dividend, as before, came due; and

on

on opening the Books on the 10th of Auguſt, 1747, ſold out at 102⅜ per Cent. Now reckoning, I might have made 5 per Cent. of my Money, had I kept it out of the Stocks, how ſtood this Article in point of Profit and Loſs?

18. COMPOUND INTEREST

Is that which ariſes both from Principal and its Intereſt put together, as the Intereſt becomes due, but not paid; the ſame Intereſt is allowed upon that Intereſt unpaid, as was upon the Principal, ſo it becomes a Part of the Principal; and for which Reaſon it is called Intereſt upon Intereſt, or Compound Intereſt.

It is not lawful to let out Money at Compound Intereſt, yet in purchaſing of Annuities or Penſions, and Leaſes in Reverſion, it is uſual to allow Compound Intereſt to the Purchaſer for his Ready Money, and therefore makes it neceſſary that it ſhould be underſtood.

But as it may (as well as other Caſes of Intereſt) be more conveniently performed by Decimals, ſo ſhall only here give the Rule, and two or three Examples.

RULE.

1. Find the firſt Year's Intereſt as in Caſe I. add that Intereſt to the Principal, which Sum will become the ſecond Year's Principal, and ſo on for any Number of Years.

2. Subtract the given Principal from the laſt Amount, and the Remainder will be the Intereſt required.

EXAMPLES.

1. What is the Compound Intereſt of 600*l.* forborne 3 Years at 5 per Cent. per Annum?
2. What is the Amount of 150*l.* for 5 Years at 4 per Cent. per Annum, Compound Intereſt?
3. What is the Compound Intereſt of 440*l.* 16*s.* for 4 Years 7 Months, and 15 Days, at 5 per Cent. per Annum?

Note.—When the Intereſt is required for Months and Days beſides Years, you muſt find the Intereſt for one Year more than the Number of Years given, and from that

Year's Intereſt, take Parts from, for the Months and Days, which add to the laſt Year's Intereſt, and the Sum will be the Intereſt required.

19. REBATE, or DISCOUNT,

Is the abating of ſo much on a Debt, to be paid before it becomes due, which Payment (Rebate being deducted) if put out to Intereſt for the ſame Time and Rate per Cent. per Annum, would be equal to the Sum firſt due.

RULES.

1. Find the Intereſt of 100*l.* for the Time given, and Rate per Cent. which Intereſt add to 100*l.*

2. As that Sum : is to the Intereſt of the 100*l.* or to 100 : : ſo is Debt or Sum propoſed : to the Rebate or preſent Worth required. Or ſubtract the Rebate from the given Sum, and the Remainder will be the preſent Worth, or Money to be paid down.

EXAMPLES.

1. What is the Rebate of 420*l.* for 7 Months 6 Days, at 5 per Cent. per Annum?
2. What is the preſent Worth of 100*l.* for 12 Months, at 6 per Cent.?
3. What is the Rebate and preſent Worth of 600*l.* 10*s.* 6*d.* payable in 10 Months, at 4 per Cent. per Annum?
4. What is the Diſcount of 890*l.* 16*s.* being due July 27, 1784, this being December 12, 1783, at 5 per Cent. per Annum?
5. Sold Goods to the Value of 430*l.* to be paid at two 4 Months, that is, Half at 4 Months, and the other Half at 8 Months: What muſt be diſcounted for the preſent Payment of the Whole, Diſcount being at 5 per Cent. per Annum?
6. Suppoſe I have a Legacy of 550*l.* left me on the 21ſt of May, 1784, but not to be paid till Chriſtmas-Day following; what is the preſent Worth, Diſcount allowed, at 5 per Cent. per Annum?
7. What is the preſent Worth of 3220*l.* payable as follows,

100*l.*

100*l.* at 3 Months, 60*l.* at 5 Months, and the Remainder at 9 Months; Diſcount at 6 per Cent. per Ann.?

8. Sold Goods to the Value of 400*l.* to be paid, at three 3 Months, as follows, viz. firſt $\frac{1}{3}$, ſecond $\frac{1}{4}$, and the Reſt the third Payment; what is the Diſcount, and preſent Worth of the Whole, at $4\frac{1}{2}$ per Cent. per Annum?

9. What ready Money will diſcharge a Debt of 360*l.* due at two 5 Months, that is, $\frac{1}{2}$ at 5 Months, and the Reſt at 10; Diſcount at 3 per Cent. per Annum?

10. What Difference is there between the Intereſt of 500*l.* at 5 per Cent. per Annum for 12 Years, and the Diſcount of the ſame Sum, at the ſame Rate, and for the ſame Time?

11. What ready Money will diſcharge a Debt of 13377*l.* 13*s.* 4*d.* due two Years, three Quarters, 25 Days hence, Diſcount at $4\frac{1}{2}$ per Cent. per Annum?

20. EQUATION of PAYMENTS

Is when ſeveral Debts are payable at different Times, but is mutually agreed between Debtor and Creditor, that all thoſe ſeveral Sums be paid at once, and at ſuch a Time as, that neither Party may be wronged thereby; this is called equating the Time of Payment. The common Rule is as follows.

RULE.

Multiply the Sum of each particular Payment by its Time, then add the Products together, and divide the Sum by the whole Debt, the Quotient (by this Rule) is the equated Time for the Payment of the Whole.

EXAMPLES.

1. B. owes C. 600*l.* whereof 200*l.* is to be paid at 3 Months, 150*l.* at 4 Months, and the Reſt at 6 Months; but they afterwards agreed the Whole ſhould be paid at once; required the Time?

2. A. bought of B. a Quantity of Goods, which came to 460*l.* to be paid in the following Manner, viz. 200*l.* at 7 Months, and the Reſt at 5 Months, but afterwards they

they agree to make one Payment of the Whole; I demand the equated Time?

3. C. owes D. a certain Sum, which is to be diſcharged in the following Manner, viz. $\frac{1}{2}$ at 3 Months, $\frac{1}{3}$ in 4 Months, and $\frac{1}{6}$ at 9 Months, but they afterwards agree to have but one Payment of the Whole: the equated Time is required?

4. A Debt is to be diſcharged thus, viz. $\frac{1}{4}$ preſent, $\frac{1}{4}$ at 4 Months, $\frac{1}{4}$ at 5 Months, and the reſt at 6 Months, what is the equated Time for the Whole?

5. E. is indebted to F. 240*l.* which by Agreement is to be paid at 5 Months hence; but E. is willing to pay him 40*l.* down, provided he will give him a longer Time for the Payment of the Remainder, which is agreed on: the Time of Payment is required?

21. SINGLE FELLOWSHIP,

OR

FELLOWSHIP WITHOUT TIME,

Is when two or more Perſons join their Stocks, and Trade together: To determine each Perſon's particular Share of the Gain or Loſs, in Proportion to his Principal paid into the Stock, obſerve the following

RULE.

As the Sum of the ſeveral Stocks: to the Gain or Loſs, :: ſo is each Perſon's Share in the Stock: to his Share of the Gain or Loſs.

PROOF.

Add all the Shares together, and that Sum (if right) will be equal to the whole Gain or Loſs.

EXAMPLES.

1. Two Merchants, A. and B. join in Partnerſhip; A. lays in 80*l.* B. 60*l.* and they gain 28*l.* what is each Man's Share of the ſaid Gain?

2. Three

2. Three Perſons, C. D. and E. trade together, and make a joint Stock of 824*l.* and in three Years Time they gained as much, and 70*l.* over; C.'s Stock was 320*l.* D.'s 340*l.* I demand E.'s Stock, and what each Perſon gained by trading?
3. Suppoſe four Merchants, A. B. C. and D. join their Stocks and Trade together, of which A. put in $\frac{1}{2}$, B. $\frac{1}{4}$, C. $\frac{1}{4}$ and D. $\frac{1}{5}$, but, at the Expiration of 12 Months, they had the Misfortune to loſe 120*l.* what muſt each Perſon ſuffer of the ſaid Loſs?
4. Three Merchants, D. E. and F. in Partnerſhip together, and with one commmon Stock of 400*l.* they gained as follows, viz. D. 30*l.* E. 48*l.* and F. 42*l.* what was each Man's Stock?
5. Suppoſe the Money and Effects of a Bankrupt, amounted to 2420*l.* 17*s.* 6*d.* and he is indebted as follows, viz. to A. 1000*l.* to B. 640*l.* to C. 900*l.* and to D. 842*l.* 16*s.* how muſt his Effects be divided amongſt them, that is, what muſt each have?

QUESTIONS for Exerciſe at Leiſure Hours.

6. A Father, ignorant in Numbers, ordered 500*l.* to be divided amongſt his five Sons, thus, give A. ſays he, $\frac{1}{3}$, B. $\frac{1}{4}$, C. $\frac{2}{5}$, D. $\frac{1}{6}$, and E. $\frac{1}{7}$: Part this equitably amongſt them, according to the Father's Intention?
7. Three Perſons purchaſe together a Weſt-India Sloop, towards which A. advanced $\frac{1}{4}$, B. $\frac{1}{7}$, and C. 140*l.* how much paid A. and B. and what part of the Veſſel had C.?
8. A. and B. clear by an Adventure at Sea 50 Guineas, with which they agree to buy a Horſe and Chaiſe; whereof they were to have the Uſe, in Proportion to the Sums adventured, which was found to be A. 10: to B. 7; they cleared 45 per Cent.; what Money then did each ſend abroad?
9. A. and B. join their Stocks, and veſt them in Brandies. A.'s Stock was 19*l.* 19*s.* 8*d.* more than that of B.; now by ſelling out their Commodity at 55*s.* per Anchor, A. cleared 74*l.* 11*s.* and B. juſt 50 Guineas. The Quantity of Brandy dealt for is required, and the Gain upon the Anchor?

10. In

10. In an Article of Trade, A. gains 14*s.* 6*d.* and his Adventure was 35*s.* more than B.'s, whoſe Share of the Profit is but 8*s.* 6*d.* what are the Particulars of their Stock?

11. Three Perſons, A. B. and C. entered in joint Trade, to which A. contributed 210*l.* B. 312*l.* they cleared 140*l.* whereof 37*l.* 10*s.* belongs of Right to C. That Perſon's Stock, and the ſeveral Gains of the other two, are required?

12. A. and B. venturing equal Sums of Money, clear by joint Trade 154*l.* by Agreement A. was to have 8 per Cent. becauſe he ſpent Time in Execution of the Project, and B. was to have only 5. The Queſtion is, what was allotted A. for his Trouble?

13. A. B. and C. are three Horſes belonging to different Men, and are employed as a Team to draw a Load of Wheat from Hertford for 30*s.* A. and B. are deemed to do $\frac{2}{7}$ of the Work, A. and C. $\frac{3}{8}$, and B. and C. $\frac{1}{16}$ of it; they are to be paid proportionally, and do you know how to divide it as it ſhould be?

14. Bought 100 Quarters of Malt, Meal, and Oat-meal, together, for 142*l.* For every 5 Buſhels of Malt, I had 3 of Meal; for every 8 of Meal, I had 7 of Oat-meal: Pray what did theſe coſt me ſeverally a Buſhel, the Malt being half as dear again as the Meal, and the Meal being double the Price of the Oat-meal?

15. In raiſing a joint Stock of 400*l.* A. advanced $\frac{4}{13}$. B. $\frac{12}{11}$ of $\frac{3}{8}$. C. $\frac{1}{8}$ more; the Difference between A.'s Adventure and B.'s, and D. the reſt of the Money; what did every one ſubſcribe?

22. DOUBLE FELLOWSHIP,

OR

FELLOWSHIP WITH TIME.

Is when each Perſon's Stock continues unequal Time in Company, ſo that a Conſideration muſt be made of the Time, as well as of the Stock.

RULE.

RULE.

Multiply each Perſon's Stock by the Time it has continued in Trade, and proceed with the Products, as with the particular Stocks in Single Fellowſhip.

PROOF.

As in Single Fellowſhip.

EXAMPLES.

1. Three Merchants, A. B. and C. enter into Partnerſhip, thus; A. puts into the Stock 240*l.* for 4 Months, B. 120*l.* for 6 Months, and C. 200*l.* for 8 Months; with this joint Stock they traffic and gain 260*l.* it is required to find each Perſon's Share of the Gain, proportionable to his Stock and Time of employing it?
2. A Ship's Company take a Prize, Value 4000*l.* which they agree to divide amongſt them, according to their Pay and Time they have been on board; now the Officers and Midſhipmen have been on board 4 Months, and the Sailors 3; the Officers have 50*s.* a Month, the Midſhipmen 40*s.* and the Sailors 28*s.* moreover, there are 4 Officers, 8 Midſhipmen, and 120 Sailors: I demand to know what each Perſon's Share is of the ſaid Prize?
3. A. B. and C. rent a Piece of Land, for which they pay 40*l.* per Annum; A. puts in 60 Oxen for 4 Months, B. 40 Oxen for 5 Months, and C. 30 Oxen for the Remainder of the Year; what muſt each Perſon pay of the ſaid Rent?
4. Three Merchants, A. B. and C. in Partnerſhip together for a Year, put into one common Stock as follows, viz. A. put in 400*l.* and at 6 Months End withdraws 200*l.* B. puts in 360*l.* and at 7 Months End 100*l.* more, but at the End of 9 Months he takes out 120*l.* C. puts in 190*l.* and at 8 Months End 110*l.* more, but at the End of 10 Months he takes out 100*l.* they gain 460*l.* what is each Man's Share?

QUES-

QUESTIONS for Exerciſe at Leiſure Hours.

5. A. and B. in Partnerſhip equally divide the Gain; A.'s Money, which was 84*l.* 12*s.* 6*d.* lay for 19 Months, and B.'s for no more than 7; the Adventure of the latter is ſought?

6. A. for 9 Months Adventure received 20*l.* B. for one of 7 Months received 25 Guineas, and C. for lying out of his Contributions 5 Months, had a Title to 32*l.* The Total of their Adventures multiplied into their reſpective Times, was 640*l.* what then were the Particulars?

7. A. clears 13*l.* in 6 Months, B. 18*l.* in 5 Months, and C. 23*l.* in 9 Months, with a Stock of 72*l.* 10*s.* what then did the general Stock Amount to?

8. X. Y. and Z. in Company, make one common Stock of 4262*l.* X.'s Money was in 4 Months, Y.'s 6 Months, and Z.'s 9 Months, they gained 420*l.* which was to be divided in the following Manner, viz. $\frac{1}{2}$ of X.'s Gain, to be equal to $\frac{1}{3}$ of Y.'s, and $\frac{1}{3}$ of Y.'s Gain to be equal to $\frac{1}{4}$ of Z.'s. Quere, what each Perſon gained and put in?

9. A. B. and C. in Company; A. put in his Share of the Stock for 5 Months, and laid Claim to $\frac{1}{3}$ of the Profits, B. put in his for 8 Months, C. advanced 400*l.* for 7 Months, and required on the Balance $\frac{1}{3}$ of the Gain; the Stock of the other two Adventurers is ſought?

10. A. and B. paid equally for a Horſe, Feb. 7, 1771; A. on the 10th, took him a Journey in the Weſt, and returned on the 10th of June following; B. on the 2d of Auguſt took him into Scotland, and ſtayed till Nov 13, and this concluded his Service for this Year. From Jan. 17th following, A. uſed him ten Days, and in ſix Weeks after his Return, employed him till April 30th, B. then rode him from May-day to Midſummer, A. had him from the 14th of July, to 14 Days after St. James's Tide; B. on Sept. 30th, took him into Norfolk, and came back Oct. 19th; he then was ſold for 7*l.* 10*s.* and they would have the Money parted equitably between them, viz. in Proportion to the Uſe each made of their Steed?

23. BARTER

Is the changing of one Commodity for another, and informs us how to Proportion the Value of any Goods, ſo that neither Party may ſuſtain Loſs. And if the Commodities exchanged are not of equal Value, the Defect is ſupplied with Money.

RULES.

1. Find the Value of that Commodity, whoſe Quantity is given, then find what Quantity of the other, at the given Rate, you can have for the aforeſaid Value, which Quantity will be the Anſwer.

2. When one has Goods at a certain Price ready Money, but in Barterage advances it to ſomething more, ſay, As the ready Money Price of the one : is to its Bartering Price : : ſo is the ready Money Price of the other to its Bartering Price; then the Quantity of the latter Commodity may be found either from the ready Money, or Bartering Price.

EXAMPLES.

1. How much Sugar, at 1*l.* 10*s.* per cwt. muſt be given in Barter, for 4 cwt. of Tea, at 12*s.* per Pound?
2. How many Yards of Cloth, at 18*s.* per Yard, muſt I give for 45 Yards of Shalloon, at 16*d.* per Yard?
3. A. and B. Barter: A. hath 30 cwt. of Prunes, at 6*d.* per lb. ready Money, but in Barter will have 7½*d.* per lb. B. hath Hops worth 36*s.* per cwt. ready Money; what ought B. to rate his Hops in Barter, and what Quantity muſt be given for the 30 cwt. of Prunes?
4. A. hath Tea at 8*s.* 6*d.* per lb. ready Money, but in Barter will have 10*s.* per lb. B. hath Tobacco worth 18*d.* per lb. ready Money; how muſt B. rate his Tobacco per lb. that his Profit may be equivalent with A.'s?

QUESTIONS for Exerciſe at Leiſure Hours.

5. A. has Currants worth 4*d.* per lb. but in Truck charges 6*d.* and alſo requires one Half of that in ready Money; B. has Candles worth 6*s.* 8*d.* the Dozen, and he in Barter, honeſt Man, charges but 7*s.* Should theſe Perſons deal together for the Value of 20*l.* how much will A. have got of B.?

6. A. lets B. have a Hogſhead of Sugar, Weight 18 cwt. worth 31*s.* for 42*s.* per cwt. one-third of which he is to pay in Caſh; B. hath Paper worth 14*s.* the Ream, which it is agreed ſhall bear no more than 15*s.* 6*d.* at that Rate, and Truck for the Reſt: how ſtood the Account?

7. A. has Kerſeys at 4*l.* 5*s.* a Piece, ready Money; in Barter they are charged by him at 5*l.* 6*s.* each, and ⅓ of that required down: B. has Flax at 3*d.* per lb. how ought he to rate it in Truck, not to be hurt by the Extortion of A.?

8. A. has 50 Broad Cloths, at 11*l.* 10*s.* a Piece, but in Change required 13*l.* taking Wool, at 2*s.* 6*d.* per Stone, of B. in return, that was really worth but 4*s.* 2*d.* a Tod: The Queſtion is, how many Sacks of Wool will pay for the Cloth, and which of the Dealers has the better in the Bargain?

9. A. with an Intention to clear 30 Guineas on a Bargain with B. rates Hops at 16*d.* per lb. that ſtood him in 10*d.* B. apprized of that, ſet down Malt, which coſt 20*s.* a Quarter, at an adequate Price; how much Malt did they contract for?

10. A. in order to put off to B. 720 Ells of damaged Holland, worth 5*s.* an Ell, at 6*s.* 8*d.* propoſe, in Caſe he has Half the Value in Money, to give B. thereon a Diſcount of 10 per Cent. the reſt A. is to take out in Saffron, which B. apprized of the whole Management, rates in Juſtice at 30*s.* the Pound; pray what was it really worth in ready Money, and what Quantity of Saffron was he to deliver on the Change?

11. A. has 100 Reams of Paper, at 8*s.* ready Money, which in Barter he ſets down at 10*s.* B. ſenſible of this, has Pamphlets at 6*d.* a Piece ready Money, which he adequately charges, and inſiſts, beſides, on ¼ of the Price of

of thoſe he parts with in Specie; what Number of the Books is he to deliver in Lieu of A.'s Paper, what Caſh will make good the Difference, and how much is B. the Gainer by this Affair?

12. A. and B. Barter; A. has 140 lb. 11 oz. of Plate, at 6*s.* 4*d.* the Ounce, which in Truck he rates at 7*s.* 2*d.* an Ounce, and allows a Diſcount on his Part, to have $\frac{1}{7}$ of that in ready Specie; B. has Tea worth 9*s.* 6*d.* the lb. which he rates at 11*s.* 2*d.* When they come to ſtrike the Balance, A. received but 7 cwt. 2 qrs. 18 lb. of Tea: Pray what Diſcount did A. allow B. which of them had the Advantage, and how much, in an Article of Trade thus circumſtanced?

13. A. and B. Truck; A. has 14 cwt. 2 qrs. 25 lb. of Farnham Hops, at 2*l.* 19*s.* per cwt. but in Barter inſiſts on 3 Guineas; B. has Wine worth 6*s.* per Gallon, which he raiſes in Proportion to A.'s Demand on the Balance; A. received but a Hogſhead and a Half of Wine: Pray what had he in ready Money?

24. LOSS and GAIN

Is a Rule by which we diſcover the Gain or Loſs by any Parcel of Goods, and ſo inſtructs us how to raiſe or fall the Price of any Commodity in ſuch Proportions, that neither our Gain may be ſo exorbitant as to injure our Cuſtomers, nor our Loſs ſo great as to impoveriſh ourſelves; which is generally at ſo much per Cent.

In this Rule there are great Variety of Examples, all of which may be eaſily ſolved (with a little Conſideration) by the following Proportion.

When the Quantity loſt and gained of the Whole is given, to find the Value of any Part thereof.

RULE.

Say, As the whole Quantity of Goods: is to the Sum of the whole Coſt and propoſed Gain:: ſo is any Part of ſaid Goods: to the Price they muſt be ſold for.

When the propoſed Gain or Loſs is at ſo much per Cent. make 100*l.* with the Gain or Loſs added to it, your 2d Term.

EXAMPLES.

1. Bought 240 Yards of Cloth, at 14*s.* 6*d.* per Yard, and ſold it again at 18*s.* per Yard. What did I gain by the Whole?
2. Suppoſe I give 46*l.* for 9 cwt. 2 qrs. 18 lb. of Sugar, at what Rate muſt I ſell it at per lb. to gain 12 Guineas by the Whole?
3. If I buy Tea at 8*s.* 6*d.* per lb. and ſell it again for 10*s.* 6*d.* what is the Gain per Cent.?

The five following Examples, in the Authors mentioned, are wrong anſwered, which is the Reaſon of my inſerting them here;—the Error conſiſts in the ſtating the Queſtion, by making the Gain or Loſs of 100*l.* the 2d Term, inſtead of its Amount.

4. If by ſelling Cloth at 5*s.* per Ell, I gain 8*l.* per Cent. what ſhall I gain per Cent. if I ſell the Ell at 6*s.* 3*d.*? (*Webſter*, 2d Ed. p. 32.)
5. At 5*s.* per Dozen, I gain 7*l.* 10*s.* per Cent. how much ſhall I gain per Cent. if I ſell the Dozen at 5*s.* 9*d.*? (*Stonehouſe*, 2d Edit. p. 103.)
6. A Mancheſter Tradeſman going to a Fair, ſold Fuſtians for 11*s.* 6*d.* the End, wherein was gained 15*l.* per Cent. but ſeeing no other Tradeſman had ſo good, raiſed them, at the latter End of the Fair, to 12*s.* the End; I demand what he gained per Cent. by this laſt Sale? (*Hill*, p. 289.)
7. Suppoſe I ſell 500 Deals at 15*d.* per Piece, and 9*l.* per Cent. Loſs; what do I loſe by the whole Quantity? (*Dilworth*, 2d Edit. p. 73.)
8. Suppoſe I ſell 1 cwt. of Hops for 6*l.* 15*s.* and Gain 25*l.* per Cent. what would have been the Gain per Cent. if I had ſold them for 8*l.* per Cent.? (*Wolkingham*, 3d Edit. p. 70.)
9. If by ſelling Hops at 3*l.* 10*s.* per cwt. the Planter clears 30 per Cent. what was his Gain per Cent, when the ſame Goods ſold for 4*l.* and a Crown?
10. Sold a repeating Watch for 50 Guineas, and by ſo doing loſt 17 per Cent. whereas I ought in dealing to have cleared

cleared 20 per Cent. then how much was it ſold under the juſt Value?

QUESTIONS for Exerciſe at Leiſure Hours.

11. If by ſending Pewter to Turkey, and parting with it at $35\frac{2}{7}$*d.* per lb. the Merchant clears Cent. per Cent. what does he clear in Holland, where he diſpoſes of the cwt. for 8*l.*?
12. Bought Hoſe in London, at 4*s.* 3*d.* the Pair, and ſold them afterwards in Dublin at 6*s.* the Pair; now taking the Charges at an Average to be 2*d.* the Pair, and conſidering that I muſt loſe 12 per Cent. by remitting my Money home again, what do I gain per Cent. by this Article of Trade?
13. If my Factor at Leghorn return me 800 Barrels of Anchovies, each weighing 14 lb. Net, worth $12\frac{1}{2}$*d.* per lb. in lieu of 7490 lb. of Virginia Tobacco, and if I find that I have gained after the Rate of 17*l.* per Cent. by the ſaid Conſignment, pray how was my ſaid Tobacco invoiced per lb. to the Factor, that is, what was the prime Coſt?
14. Bought Comfits to the Value of 41*l.* 3*s.* 4*d.* for 3*s.* 1*d.* per lb. it happened, that ſo many of them were damaged in Carriage, that by ſelling what remained good, at 4*s.* 6*d.* per lb. my Returns were no more than 34*l.* 2*s.* 6*d.* Pray how much of theſe Goods were ſpoiled, and what did this Part ſtand me in?
15. A Stationer ſold Quills at 11*s.* per Thouſand, by which he cleared $\frac{1}{8}$ of the Money; but they growing ſcarce, raiſed them to 13*s.* 6*d.* per Thouſand: What might he clear per Cent. by the latter Price?
16. A. had 15 Pipes of Malaga Wine, which he parted with to B. at $4\frac{1}{2}$ per Cent. profit, who ſold them to C. for 381*l.* 11*s.* 6*d.* Advantage; C. made them over to D. for 500*l.* 16*s.* 8*d.* and cleared thereby $6\frac{1}{2}$ per Cent. what did this Wine coſt A. per Gallon?
17. Laid out in a Lot of Muſlin 480*l.* 12*s.* upon Examination of which, two Parts in ſeven proved damaged; ſo that I could make but 5*s.* 6*d.* a Yard of the ſame; and by ſo doing, find I loſt 48*l.* 18*s.* by it, at what

Rate per Ell am I to part with the undamaged Muſlin, to make up my ſaid Loſs?

25. ALLIGATION MEDIAL

Is when the Price and Quantity of ſeveral Commodities are given to be mixed, to find the mean Price of that Mixture.

RULE.

As the whole Compoſition : is to its total Value : : ſo is any Part thereof : to its mean Price.

PROOF.

Find the Value of the whole Mixture at the mean Rate, and if it agrees with the Total Value of the ſeveral Quantities at their reſpective Prices, the Work is right.

EXAMPLES.

1. A Wine-Merchant mingles 14 Gallons of Mountain Wine, at 8*s.* per Gallon, with 12 Gallons at 6*s.* per Gallon, 10 Gallons of Sherry at 7*s.* per Gallon, 20 Gallons of White Wine, at 4*s.* per Gallon, and 8 Gallons of Canary, at 9*s.* per Gallon: How may he ſell this Mixture per Gallon?
2. With 13 Gallons of Canary, at 6*s.* 8*d.* a Gallon, I mingled 20 Gallons of White Wine, at 5*s.* a Gallon; and to theſe add 10 Gallons of Cyder, at 3*s.* a Gallon: At what Rate muſt I ſell a Quart of this Mixture, ſo as to clear 10 per Cent.?

26. ALLIGATION ALTERNATE,

Is when the Rates of ſeveral Commodities are given, to find ſuch Quantities of them, as being mixed together ſhall bear a Price propounded.

RULES.

RULES.

1. The Rates (if not already) muſt all be reduced to one Denomination.

2. Set down the Rate, or Prices, in a Column under one another, and the mixed or mean Rate on the left Hand of theſe.

3. Connect or link together the ſeveral Rates, ſo that every one leſs than the mean, be linked with ſome one greater, or with as many as you pleaſe, that are greater, and every great with one leſs, or with as many leſs as you pleaſe.

4. Take the Difference between each Price and the mean Rate, and ſet them alternately, and if only one Difference ſtand againſt any Rate, it will be the Quantity belonging to that ſaid Rate; but if there are ſeveral, then their Sum will be the Quantity, which Quantities are the Anſwer for that Rate, againſt which they ſtand.

EXAMPLES.

3. To mix Gold of 18 Carrats fine with that of 23 Carats fine, of 19, and of 16 Carats fine, ſo that the Compoſition may be 20 Carats fine; what Quantity of each muſt be taken?

4. A Grocer would mix a Quantity of Sugar at 10*d.* per lb. with other Sugars, at $7\frac{1}{2}$*d.* 5*d.* and $4\frac{1}{2}$*d.* per lb. intending to make up a Commodity worth 6*d.* per lb. In what Proportion is he to take of thoſe Sugars?

27. ALLIGATION PARTIAL

Is when the Price of each Simple is given, alſo the Quantity of one of them, and the mean Rate, to find the ſeveral Quantities of the Reſt in Proportion to that given.

RULES.

1. Take the Difference between each Price and the mean Rate as in the laſt Rule.

2. As

2. As the Difference of that Simple, whoſe Quantity is given : is to the known Quantity : : ſo is any other Difference : to the Quantity of its oppoſite Name.

EXAMPLES.

5. How much Tea at 6*s.* 6*d.* 7*s.* 6*d.* and 9*s.* per lb. muſt be taken to be mixed with 36 lb. at 12*s.* per lb. that the Mixture may be worth 8*s.* per lb.?
6. A Tobacconiſt has by him 120 lb. of fine Oroonoko Tobacco, worth 2*s.* 6*d.* a Pound; to this he would mix York-River ditto at 20*d.* and other inferior Tobaccos at 18*d.* and 15*d.* a Pound, as will make up a Mixture anſwerable to 2*s.* a Pound: What will this Parcel weigh?

28. ALLIGATION TOTAL

Is when the Price of each Simple is given, as alſo the mean Rate, and what Quantity of the Compound, to find how much of each Sort will make that Quantity.

RULES.

1. Take the Difference between each Price, and the mean Rate as before.
2. Say, as the Sum of theſe Differences : is to the whole Quantity of the Mixture : : ſo is each particular Difference : to its particular Quantity.

EXAMPLES.

7. How much Gold of 16, of 18, and 23 Carats fine, muſt be mixed together, to form a Compoſition of 60 oz. of 20 Carats fine?
8. A Druggiſt has by him 4 Sorts of Green Tea, viz. of 5*s.* 6*s.* 8*s.* and 9*s.* per lb. out of theſe he is inclined to mix up a Canniſter, containing Net a Hundred and a Half, ſo as to make the Commodity worth 7*s.* the Pound. In what Proportion muſt thoſe Teas be taken?

29. EXCHANGE

Is the receiving in one Country for the Value paid in another.

The Par of Exchange is always fixed and certain, it being at the intrinsic Value of any foreign Money compared with Sterling, but the Course of Exchange between any two Countries rises and falls upon various Occasions.

But as it would be both needless and endless to write of every Kind of Exchange; so I shall only give a few Examples of the Exchange of England, with some of the chief Countries of Europe.

Exchange is either performed by Sect. 12, or 15, and sometimes most expeditious by the latter.

1st. With FRANCE.

They keep their Accounts at Paris, Lyons, and Rouen, in Livres, Sols, and Deniers, and Exchange by the Crown of three Livres Tournois, or 60 Sols French, and give Pence Sterling, more or less, for this Exchange Crown, which is equal to 4*s*. 6*d*. at Par.

12 Deniers
20 Sols
3 Livres
} make one {Sol. Livre. Crown.

1. To change French Money into Sterling.

RULE.

As 1 Crown : is to the given Rate : : so is the given French Sum : to the Sterling required; or by the Rules given in Practice.

2. To change Sterling Money into French.

RULE.

As the Rate of Exchange : is to 1 Crown : : so is the Sterling Sum : to the French required.

Note.—The same Rule must be observed with most of the following Countries.

EXAMPLES.

[illegible]

[illegible]

At Florence [illegible]

[illegible]

EXAMPLE

7. Genoa is [illegible] Sterling may [illegible] at 52*d.* per Dollar?

8. If a Merchant [illegible] how many Dollars [illegible] at 52*d.* per Dollar?

Note.—In St. George's Bank at Genoa [illegible] *in Piasters or Pezzos*, [illegible] *and Denarii*, as the [illegible]

But some Merchants keep their [illegible] Solide, and Deanre, [illegible] is only one Fifth in Value [illegible]

9. Change 8644 Pez. 2*s.* 6*d.* [illegible] change at 47½*d.* per Pezzo?

10. London is indebted to Genoa [illegible] many Pezzoes may Genoa [illegible] change at 47½*d.* per Pez.?

4th. With PORTUGAL

They keep their Accounts in Lisbon [illegible] Reas, and Exchange on the Mil[illegible] from 5*s.* to 5*s.* 6*d.* for the same.

400 Reas } make one [illegible]
1000 Reas }

EXAMPLE

11. A Merchant at Lisbon being [illegible] Correspondent in London [illegible] 64*d.* per Milrea, how much [illegible] London?

EXAMPLE

1. What Sterling Money must be paid i
ceive in Paris 500 Crowns; Exch
Crown?
2. How many Crowns must be paid at Pa
London 116*l.* 13*s.* 4*d.* the Exchar
Crown?
3. Change 640 Crowns, 12 Sols, 8 Deni
Crown, into Sterling?
4. Change 145*l.* 7*s.* 7½*d.* Sterling, into
Exchange at 54½*d.* per Crown?

2d. With SPAIN.

They keep their Accounts at Madrid, Cad
in Dollars, Rials, and Maravedis, and e
Piece of Eight, which is equal to 4*s.* 6*d.* at P

4 Maravedis Vellon, or 2½ Maravedis Plate	}	make one	Quartas
8½ Quartas, or 34 Maravedis Vellon	}		Rial Vel
16 Quartas, or 34 Maravedis Plate	}		Rial of P
8 Rials of Plate			Piece of

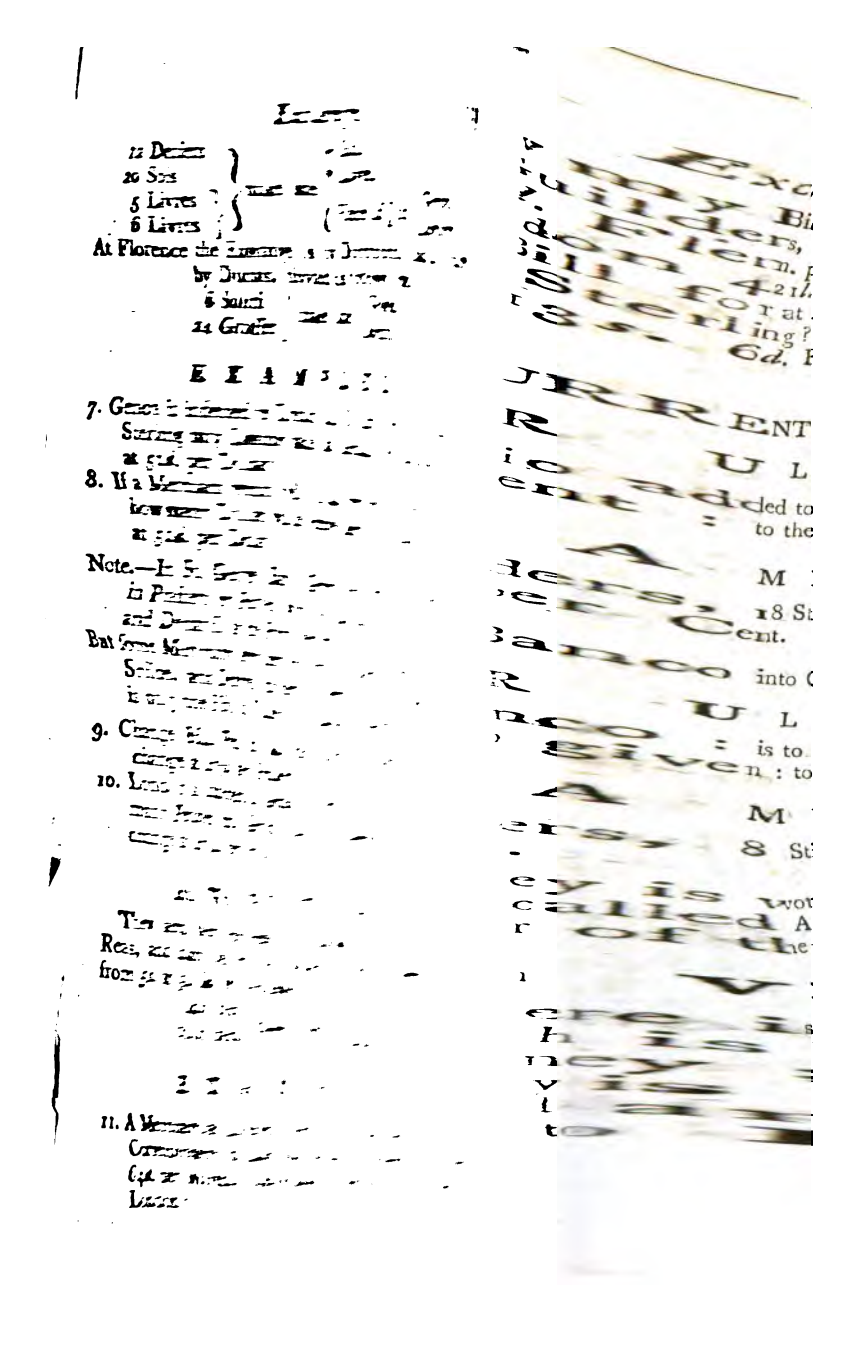
N. B. A Rial Vellon is $\frac{17}{25}$ of a Rial of Plate,
Piaſter.

EXAMPLES.

5. Change 856*l.* 6*s.* 8*d.* into Spaniſh Money,
56*d.* per Piece of Eight?
6. If I pay in Seville 1426 Pieces of $\frac{8}{7}$, 4 Rials,
vedis, what may I draw for my Bill at Lo
change at 54¼*d.* per Piece of $\frac{8}{8}$?

3d. ITALY.

In Italy they keep their Accounts at Genoa and
in Livres, Sols, and Deniers, and exchange by the
Eight or Dollar, which is equal to 4*s.* 6*d.* at Par.



12. How many Milreas will 1566*l.* 6*s.* 8*d.* amount to, Exchange at 64*d.* per Milrea?

5th. With HOLLAND, FLANDERS, and GERMANY.

In theſe Places, their Accounts are kept ſometimes in Pounds, Shillings, and Pence, as in England, and ſometimes in Guilders, Stivers, and Pennings. The Money of Holland and Flanders, is diſtinguiſhed by the Name of Flemiſh, and the Exchange is made with London, from 30 to 38 Shillings Flemiſh, per £. Sterling.

8	Pennings		Groat.
2	Groats		Stiver.
6	Stivers		Shilling.
20	Stivers	make one	Florin, or Guilder.
2½	Florins		Rix Dollar.
6	Florins		Pound Flemiſh.
5	Guilders		Ducat.

To change Flemiſh Money into Sterling; and, on the contrary, Sterling into Flemiſh, is the ſame with that of France, only what was French there, will be Flemiſh here.

To reduce Flemiſh Pounds, Shillings, and Pence, into Guilders.

RULE.

Reduce them into Pence Flemiſh, then divide by 40, (becauſe 40*d.* is equal to one Guilder) and the Quotient will be Guilders; and the Remainder (if any) divide by 2, becauſe 2*d.* is equal to one Stiver) and the Quotient will be Stivers.

EXAMPLES.

13. A Merchant in Rotterdam remits 564*l.* 10*s.* 6*d.* Flemiſh, to be paid in London, how much Sterling Money muſt he draw for, Exchange at 34*s.* 4*d.* per £. Sterling?

14. Suppoſe a Merchant delivered in London 328*l.* 16*s.* 11½*d.* to receive the Value at Amſterdam in Flemiſh Money; how many Pounds muſt he receive there, the Exchange at 34*s.* 4*d.* Flemiſh per £. Sterling?

15. What

15. What may I draw my Bill for to London, if I pay in Antwerp 4200 Guilders, 12 Stivers, 8 Pennings, Exchange at 33*s.* 3*d.* Flem. per £. Sterling?
16. If I pay in London 421*l.* 2*s.* 3*d.* how many Guilders may I draw my Bill for at Antwerp, Exchange at 33*s.* 3*d.* Flem. per £. Sterling?
17. Exchange 242*l.* 13*s.* 6*d.* Flemiſh into Guilders, Stivers, &c.

6th. To Change CURRENT MONEY into BANCO.

R U L E.

As 100 with the Agio added to it : is to 100 Banco : : ſo is any given Sum current : to the Banco required.

E X A M P L E.

18. Change 495 Guilders, 18 Stivers Current, into Banco Florins, Agio 5 per Cent.

To Change Banco into Current Money.

R U L E.

As 100 Guilders Banco : is to 100 with the Agio added to it : : ſo is the Banco given : to the Current required.

E X A M P L E.

19. Change 470 Guilders, 8 Stivers Banco into Current, Agio at $\frac{1}{8}$ per Cent.

Note.—The Bank Money is worth more than the Current, their Difference is called Agio, and is from three to 6 per Cent. in Favour of the Bank.

7. With VENICE.

Money of Exchange here is always underſtood to be that of Ducats in Bank, which is imaginary, 100 whereof make 120 Ducats Current Money; ſo that the Difference betwixt Bank and Current Money is an Agio of 20 per Cent. though the Brokers have invented another Agio to be added, which is more or leſs according to Bargain.

The Courſe of Exchange of a Ducat of the Bank of Venice is from 45*d.* to 50*d.* Sterling.

EXAMPLE.

20. Venice draws on London for 4700 Ducats, 10 Sols, 8 Den. Banco, Exchange at 47$\frac{6}{8}$ per Ducat, how much Sterling will pay the Draught?

8th. With POLAND and PRUSSIA.

Dantzick and Konigſberg Exchange with London by Way of Amſterdam and Hamburgh; 270 Poliſh Groſch being= 1*l.* Groſs Banco in Holland; 110 Poliſh Groſch being= 1 Rix-Dollar, Banco of Hamburgh.

18	Phenningen		Groſch.
3	Groſch		Ditkin.
2	Ditkins		Sixer.
3	Sixers	make one	Tymph.
7$\frac{1}{2}$	Groſch		Arch de Halber.
4	Arch de Halbers		Florin or Guilder.
3	Florins or Gilders		Current } Dollar.
4	Guilders		Specie }

EXAMPLES.

21. Change 4684 Florins into Sterling Money, 270 Groſchi Poli, per Pound Flemiſh, and 34*s.* 4*d.* Flemiſh, per £. Sterling?

22. Change 390*l.* Sterling into Florins, the Exchange being 33*s.* 4*d.* Flemiſh, per £. Sterling, and 270 Groſchi Poli, per £. Flemiſh?

9th. With RUSSIA.

3 Copecs		Altine.
10 Copecs		Grievener.
25 Copecs	make one	Polpoliton.
2 Polpolitons		Poltin.
2 Poltins		Rubble.
2 Rubbles		Ducat.

The Ruſſian Rubbles are converted into Florins Current Money of Amſterdam, and the Current into Bank Money, according

according to the Agio of three or five per Cent. and Bank Money into Sterling, according to the Courſe of Exchange between England and Amſterdam.

EXAMPLE.

23. In 6420 Rubbles, 42 Copecs, Exchange 122 Copecs per Rix-Dollar current, Agio 3 per Cent. and 34*s.* 6*d.* Flemiſh, per £. Sterling, how much Sterling Money?

10th. With IRELAND.

In Ireland they keep their Accounts in £. *s.* and *d.* Iriſh, divided as in England; but having no Coins of their own, they are ſupplied by the different Countries with which they traffic.

The Par of Exchange between England and Ireland, is 100*l.* Sterling, for 108*l.* 6*s.* 8*d.* Iriſh, or 1*s.* Engliſh=13*d.*

The Courſe of Exchange is from 5 to 12 per Cent. according to the Balance of Trade.

EXAMPLES.

24. Dublin draws upon London for 740*l.* 14*s.* 6*d.* Iriſh, Exchange at 12 per Cent. how much Sterling muſt London pay Dublin to diſcharge this Bill?

25. London remits to Ireland 651*l.* 14*s.* 11½*d.* Sterling; how much Iriſh muſt London be credited, Exchange at 12 per Cent.?

11th. With AMERICA and the WEST INDIES.

In Exchange with our Colonies in America and the Weſt Indies, Accounts are kept, and the Money divided, as in England; their Money is called Currency.

The Scarcity of Caſh obliged them to ſubſtitute a Paper-Currency for carrying on their Trade; which being ſubject to Caſualties, ſuffer a very great Diſcount for Sterling, in the Purchaſe of Bills of Exchange.

EXAMPLES.

26. Philadelphia is indebted to London 1474*l.* 16*s.* Currency, what Sterling may London reckon to be remitted, when the Exchange is 64 per Cent.?
27. London receives a Bill of Exchange from Philadelphia, for 943*l.* 17*s.* 5½*d.* Sterling; for how much Currency was London indebted, Exchange being at 64 per Cent.?
28. London consigns to Jamaica Goods, per Invoice, amounting to 640*l.* 16*s.* 9*d.* which are sold for 987*l.* 12*s.* Currency; what Sterling ought the Factor to remit, deducting 5 per Cent. for Commission and Charges; and what does London gain per Cent. upon the Adventure, supposing the Exchange at 30 per Cent.?
29. Jamaica is indebted to London 1470*l.* 12*s.* 8*d.* Sterling; with how much Currency will London be credited at Jamaica, when the Exchange is 36½ per Cent.?

A few EXAMPLES *for Exercise in this Rule.*

30. Amsterdam changes on London 34*s.* 4*d.* per £. Sterling, and on Lisbon at 52*d.* Flemish, for 400 Reas; how then ought the Exchange to go between London and Lisbon?
31. A. at Paris draws on B. of London 1200 Crowns, at 55*d.* Sterling per Crown; for the Value whereof, B. draws again on A. 56*d.* Sterling per Crown, besides Commission ½ per Cent. Did A. get or lose by this Transaction, and what?
32. V. of Amsterdam draws on X. of Hamburgh, at 67*d.* Flem. per Dollar, of 32 Sols Lubeck; and on Y. of Nuremberg, at 70*d.* Flemish per Florin, of 65 Crutzers Current: If V. has Orders to draw on X. in order to remit to Y. at the said Prices, how would run the Exchange between Hamburgh and Nuremberg?
33. M. of Amsterdam orders N. of London to remit O. of Paris at 54*d.* Sterling per Crown, and to draw on P. of Antwerp for the Value, at 33½*s.* Flem. per £. Sterling; but as soon as N. received the Commission, the Exchange was on Paris, at 54½*d.* per Crown: Pray at what

what Rate of Exchange ought N. to draw on P. to execute his Orders, and be no loſer?

34. London changes with Amſterdam on Par at 33*s.* 4*d.* Flem. per £.; Amſterdam changes on Middleburg, at 2 per Cent. How ſtands the Exchange between London and Middleburg?

35. Q. of Rotterdam remits to R. of Paris 2000 Crowns, at 91*d.* Flem. per Crown, and double Uſance, or two Months, and pays $\frac{1}{10}$ per Cent. Brokerage, with Orders to remit him again the Value, at 93*d.* per Crown, allowing at the ſame Time $\frac{1}{2}$ per Cent. for Proviſion: What is gained per Cent. per Annum, by a Remittance thus managed?

36. A. of Amſterdam owes B. of Paris 2000 Florins of current Specie, which he is to remit him, by Order, the Exchange at 90$\frac{1}{2}$*d.* Flemiſh per Crown, of 60 Sols Tournois, the Agio of the Bank being four per Cent. better than Specie; but this, when it was to be negociated, the Exchange was down at 89$\frac{1}{2}$*d.* per Crown, and the Agio raiſed to five per Cent. what did B. get by this Turn of Affairs?

29. Compariſon of WEIGHTS and MEASURES

Is when the Weights or Meaſures of different Countries are compared together, and is a very neceſſary Rule (of great Importance to the Merchant) to be acquainted with.

1. When it is required to find how many of the firſt Sort (of Weight or Meaſure mentioned in the Queſtion) are equal to a given Quantity of the laſt.

RULES.

1. Place the Numbers alternately, beginning at the Left-Hand, and let the laſt Number ſtand on the Left-Hand.

2. Multiply the firſt Rank continually together for a Dividend, and the ſecond for a Diviſor.

EXAMPLES.

1. If 100 lb. of London are equal to 113 lb. of Marſeilles, and 100 lb. at Marſeilles, are equal to 81 lb. of Amſterdam; how many Pounds at London are equal to 60 lb. of Amſterdam?
2. If 104 lb. of Engliſh are equal to $8\frac{1}{2}$ lb. of Geneva, and 100 lb. of Geneva are equal to 108 lb. at Rouen; how many Pounds Engliſh are equal to 64 lb. of Rouen?
3. Suppoſe 100 yds. Engliſh to be equal to 78 Ells French, and 78 Ells French are equal to $133\frac{1}{3}$ Ells at Amſterdam; how many Yards Engliſh are equal to 100 Ells at Amſterdam?
4. If 100 Canes of Genoa be equal to $191\frac{1}{3}$ Ells of England, and 78 Ells of Eng. be equal to $131\frac{2}{3}$ of Bruſſels, how many Canes of Genoa are equal to 100 Ells of Bruſſels?

1. When it is required to find how many of the laſt Sort (of Weight or Meaſure mentioned) are equal to a given Number of the Firſt.

RULES.

1. Place the Numbers alternately, beginning at the Left-Hand (as before) and ſet the laſt Number on the Right-Hand.

2. Multiply the firſt Row for a Diviſor, and the other for a Dividend.

EXAMPLES.

5. Suppoſe 100 lb. of Portugal be equal to 92 lb. of Antwerp, and 100 lb. of Antwerp, be equal to 110 lb. of Lyons; how many Pounds at Lyons are equal to 60 lb. of Portugal?
6. If 74 Yards of Engliſh be equal to 100 Braſſes of Florence, and 100 Braſſes of Florence be equal to 30 Canes of Marſeilles; how many Canes of Marſeilles are equal to 100 Yards Engliſh?

30. PO-

30. POSITION,

OR

The RULE of FALSE,

Is ſo called, becauſe we ſuppoſe ſome uncertain or falſe Numbers, in order, that by reaſoning from them, according to the Nature thereof, do, by thoſe falſe ſuppoſed Numbers, find the true Number ſought.

This Rule is divided into two Parts, commonly called the Single Rule, and Double Rule.

SINGLE POSITION.

By Single Poſition are anſwered all ſuch Queſtions, as require only one Suppoſition to diſcover the true Reſult.

RULE.

Make choice of your Poſition, work with that Suppoſition, according to the Nature of the Queſtion, as if it were the true Number, and if you find (after ordering your Poſition) the Reſult either too much or too little, you may then find the true Anſwer, by this Proportion, viz.

As the Reſult of your Poſition : is to the Poſition : : ſo is the given Number : to the Number ſought.

PROOF.

Add the ſeveral Parts of the Sum together, and if the Sum agrees with the given Number, it is right.

EXAMPLES.

1. Three Perſons, A. B. and C. diſcourſing concerning their Ages, ſays B. to A. I am as old and half again as old as you: then ſays C. to B. I am twice as old as you; now ſays A. to them both, I am ſure, if our Ages be added together, the ſum will be 132. I demand each Man's Age?
2. A Man, overtaking a Maid driving a Flock of Geeſe, ſaid to her, How do you do, Sweetheart? Where are you

you going with theſe 40 Geeſe? No, Sir, ſaid ſhe, I have not forty, but if I had as many more, half as many more, and 10 Geeſe beſides, I ſhould have 40. How many Geeſe had ſhe?

3. A. B. C. and D. were in Company together; A. told C. that he was older than him by 4 Years; B. told them, that he was as old as both of them together, and 9 Years older; D. hearing them, ſaid, I am juſt 45 Years old, and that is equal to the Sum of your Ages added together. How old was each of them added together? How old was each of them ſeverally?

4. Three Perſons, viz. Andrew, Benjamin, and Chriſtopher, are to go a Journey of 469 Miles; of this Journey, Andrew is to go a certain Number of Miles unknown; Benjamin is to go three Times as many Miles as Andrew, and one League more; and Chriſtopher is to go twice as many Miles as Benjamin, and 16 Miles more. How many Miles muſt each of theſe Perſons travel ſeverally?

5. Admit three Merchants, A. B. and C. to build a Ship, which coſt them 2000*l.* of which A. pays a certain Part unknown; B. paid $3\frac{1}{2}$ as much, wanting 45*l.* 15*s.* and C. paid as much as both A. and B. together, and 26*l.* 10*s.* more. How much did each Perſon pay?

6. I have a Ciſtern, with three unequal Cocks, containing 60 Pipes of Water, the greater Cock will empty the Ciſtern in one Hour, the ſecond in two, and the third in three. In what Time will they empty the Ciſtern, ſuppoſing they all be ſet open at once?

7. A General being aſked the Number of Men his Army conſiſted of, anſwered that $\frac{1}{4}$ of $\frac{1}{5}$ amounted to 900. What Number of Men had he?

8. A Schoolmaſter was aſked how many Scholars he had, anſwered, If I had as many, $\frac{1}{2}$ as many, $\frac{1}{3}$ as many, and $\frac{1}{4}$ as many, I ſhould have 333. How many had he?

31. DOUBLE POSITION

Is when two Suppoſitions are uſed; and if we miſs in both (as it generally happens) obſerve the Nature of the Errors, whether they be greater or leſs than the given Number, and accordingly they muſt be made uſe of thus.

RULES.

RULES.

1. Place the Error againſt its reſpective Poſition, and multiply them croſs-wiſe.

2. If the Errors are alike, that is, both greater, or both leſs, than the given Number, take their Difference for a Diviſor, and the Difference of their Products for a Dividend.

But if unlike, that is, one too much, and the other too little, then take their Sum for a Diviſor, and the Sum of their Products for a Dividend, the Quotient will be the Anſwer.

EXAMPLES.

1. A Gentleman hath two Horſes of good Value, and a Saddle worth 50*l.* which if ſet on the Back of the firſt Horſe will make his Value double that of the ſecond; but if ſet on the Back of the ſecond Horſe makes his Value triple of that of the firſt Horſe. I demand the Value of each Horſe?

2. Double my Money for me, ſaid A. to B. and I will give thee 6*d.* out of the Stock; with the Remainder he applied in the like Manner to C. with equal Succeſs; and gave him alſo 6*d.* he repeated this Propoſal to D. and then 6*d.* was all he had to give. Pray, what Sum had he to begin with?

3. Three Gentlemen, A. B. and C. playing at Hazard together, the Money ſtaked was 112 Guineas, but diſagreeing, each ſeized as many as he could; A. got a certain Quantity, B. as many as A. and 16 more; but C. got only a 6th Part of their Sum; how many had each?

4. A Boy ſtealing Apples was taken by Mad Tom, and to appeaſe him gives half he had, and Tom gives him back 10; in his return home he was met by Raving Ned, who took from him one Half of what he had left, and gave him back 4; after that, unlucky Poſitive Jack meets him, when he gave him one Half of what he had left, and he returns him back 1: at laſt getting ſafe away he finds he has 18 left. How many had he at firſt?

5. A

5. A Son aſked his Father how old he was; his Father replied, Your Age is now $\frac{1}{3}$ of mine; but 4 Year's ago, your Age was only $\frac{1}{7}$ of what mine is now. What were their Ages?
6. There is a certain Fiſh, whoſe Head is nine Inches long, the Tail as long as the Head and half the Body, and the Body is as long as both the Head and the Tail. I demand the whole Length of the ſaid Fiſh?
7. To find a Number, which if added to itſelf and the Sum multiplied by the ſame, and the ſame Number ſtill ſubtracted from the Product: and, laſtly, the Remainder divided by the ſame, that it may produce 13.

QUESTIONS for Exerciſe at Leiſure Hours.

8. When firſt the Marriage-Knot was ty'd
Betwixt my Wife and me,
My Age did her's as far exceed
As three Times three does three;
But when ten Years, and Half ten Years,
We Man and Wife had been,
Her Age came up as near to mine
As eight is to ſixteen.
Now, tell me, I pray,
What were our Ages on the Wedding Day?

9. A Gentleman finding ſeveral Beggars at his Door, gave to each Fourpence, and had Sixteen Pence left; but if he had given to each Sixpence, he would have wanted Twelve Pence. How many Beggars were there?
10. To find a Number, which being multiplied by 3, ſubtract 5 from the Product; and the Remainder divided by 2, if the Number ſought be added to the Quotient, that the Sum may be 40.
11. Two Companions have got a Parcel of Guineas; ſays A. to B. if you will give me one of your Guineas, I ſhall have as many as you will have left. Nay, replies B. if you will give me one of your Guineas, I ſhall have twice as many as you will have left. How many Guineas had each of them?
12. A Son aſked his Father how old he was? his Father anſwered

anſwered him thus: If you take away 5 from my Years, and divide the Remainder by 8, the Quotient will be $\frac{1}{3}$ of your Age; but if you add 2 to your Age, and multiply the Whole by 3, and then ſubtract 7 from the Product, you will have the Number of the Years of my Age. What was the Age of the Father and Son?

13. Two Men have a mind to purchaſe a Houſe rated at 1200*l.* ſays A. to B. if you give me $\frac{2}{3}$ of your Money, I can purchaſe the Houſe alone; but ſays B. to A. if you will give me $\frac{1}{4}$ of your's, I ſhall be able to purchaſe the Houſe. How much Money had each of them?

14. Suppoſe the Number 50 was to be divided into two Parts, ſo the greater Part being divided by 7, and the leſſer multiplied by 3, the Sum of this Product, and the former Quotient, may make the ſame Number propoſed, which was 50.

15. A certain Man hires a Labourer on this Condition, that for every Day he worked he ſhould receive 12 Pence, but for every Day he was idle he ſhould be mulcted 8 Pence: When 390 Days were paſt, neither of them were indebted to one another. How many Days did he work, and how many was he idle?

16. A Perſon being aſked how old he was, anſwered, If I quadruple $\frac{2}{3}$ of my Years, and add $\frac{1}{2}$ of them + 50 to the Product, the Sum will be ſo much above 100 as the Number of my Years is now below 100.

17. A certain Perſon bought two Horſes, with the Trappings, which coſt 100*l.* which Trappings, if laid on the firſt Horſe A. both the Horſes will be of equal Value; but if the Trappings be laid on the other Horſe, he will be double the Value of the firſt. How much did the Horſes and Trappings coſt?

18. A young Gentleman, at the Age of 21 Years, was told by his Guardian, that his Fortune conſiſted in Caſh, to the Amount of 7400*l.* and that his Father died when he was but 10 Years old, and the Money your Father left, ſaid the Guardian, I have allowed you 5 per Cent. per Ann. for ſimple Intereſt, only I have deducted 100*l.* per Ann. for your Education, &c.

What

What was the Son's Fortune that was left by the Father?

32. PROGRESSION

Conſiſts of two Parts,

ARITHMETICAL and GEOMETRICAL.

ARITHMETICAL PROGRESSION.

Is when a Rank or Series of Numbers increaſe or decreaſe by a common Difference, or by a continual adding or ſubtracting ſome equal Numbers.

As $\left\{\begin{matrix}1,2,3,4,5,6,7,8,\\8,7,6,5,4,3,2,1,\end{matrix}\right\}$ Here the common Difference is 1.

Or, 1,3,5,7,9,11,13. Here the common Difference is 2.

Alſo 35,30,25,20,15,10,5. Here the common Difference is 5.

1. In any Series of Numbers in Arithmetical Progreſſion, when the Number of Terms are even, as 1,3,5,7,9,11, or the like, the Sum of the two Extremes will be equal to the Sum of any two Means that are equally diſtant from the Extremes;

Viz. 1,3,5,7,9,11.

$1+11=5+7=3+9=12.$

2. When the Number of Terms are odd, as 2,4,6,8,10, the Double of the middle Figure or Term will be equal to the Sum of the Extremes, or to any two Means equally diſtant from the middle Term;

Viz. 2,4,6,8,10.

$6\times 2=4+8=2+10=12.$

In Arithmetical Progreſſion there are five Things to be obſerved, viz.

1. The firſt Term.
2. The laſt Term.
3. The Number of Terms.
4. The common Exceſs or Difference.
5. The Aggregate or Sum of all the Terms.

Any three of which being given, the other two may be found.

PRO-

PROPOSITION I.

When two Extremes and the Number of Terms are given, to find the Sum of all the Series or Terms.

RULE.

Multiply the Sum of the two Extremes into the Number of Terms, and divide the Product by 2. The Quotient will be the Sum of all the Series, or multiply the Sum of the two Extremes by Half the Number of Terms.

EXAMPLES.

1. How many Strokes do the Clocks at Venice (which go on to 24 o'Clock) ſtrike in the Compaſs of a natural Day?
2. How many Strokes do the Hammer of a Clock ſtrike in 12 Hours?
3. The Length of my Garden is 94 Feet; now if Eggs be laid along the Pavement a Foot aſunder, and be fetched up ſingly to a Baſket, removed one Foot from the firſt, how much Ground does he traverſe that does it?
4. Suppoſe 100 Stones were placed in a right Line, a Yard diſtant from one another, and the firſt Stone was one Yard from a Baſket; I demand how many Miles he muſt travel that gathers them ſingly into the Baſket?
5. A Butcher buys 100 Sheep, and gave for the firſt Sheep 1*s.* and for the laſt 9*l.* 19*s.* I demand what he gave for the 100 Sheep?

PROPOSITION II.

When the two Extremes and Number of Terms are given, to find the common Difference.

RULE.

The Difference of the two Extremes divided by the Number of Terms leſs an Unity or 1, the Quotient will be the common Difference.

EXAMPLES.

6. One had 20 Children that differed alike in their Ages, the youngeſt was 5 Years old, the eldeſt 43; what was the Difference of their Ages, and the Age of each?
7. A running Footman (for a Wager) is to travel from London to a certain Place Northwards, in 19 Days, and to go but 6 Miles the firſt Day, increaſing every Day's Journey by an equal Exceſs, ſo that the laſt Day's Journey may be 60 Miles: I demand each Day's Journey, and the Diſtance of the Place he goes to, is from London?
8. A Debt is to be diſcharged at 10 different Payments in Arithmetical Progreſſion; the firſt Payment is to be 5*l.* and the laſt 50*l.* What is the whole Debt, and what muſt each Payment be?

PROPOSITION III.

When the two Extremes and the common Difference are given, to find the Number of Terms.

RULE.

Divide the Difference of the two Extremes by the common Exceſs or Difference, add Unity or 1, to the Quotient, and the Sum will be the Number of Terms.

EXAMPLES.

9. A Man being aſked how many Children he had, anſwered, my youngeſt Child is 5 Years old, and the eldeſt 43, and that he had increaſed one in his Family every two Years; how many Children had he?
10. A Perſon travelling from London Northward, went 6 Miles the firſt Day, and increaſed every Day's Journey 3 Miles, till at laſt he went 60 Miles in one Day: how many Days did he travel?

PROPOSITION IV.

When the laſt Term, the common Difference, and the Number of Terms are given, to find the firſt Term.

RULE.

RULE.

Multiply the Number of Terms leſs Unity or 1, by the common Difference, the Product ſubtracted from the laſt Term leaves the firſt.

EXAMPLES.

11. A Man in 19 Days went from London to a certain Place in the Country, every Day's Journey was greater than the preceding one by 3 Miles, his laſt Day's Journey was 60 Miles, what was the firſt?
12. A Perſon takes out of his Pocket, at 10 different Times, ſo many different Number of Guineas, every one exceeding the former by two, the laſt was 23, what was the firſt?

PROPOSITION V.

When the Number of Terms, common Difference, and the Sum of all the Terms are given, to find the firſt Term.

RULE.

Divide the Sum of all the Series by the Number of Terms, and from that Quotient ſubtract Half the Product of the common Difference, multiplied by the Number of Terms leſs one, gives the firſt Term.

EXAMPLES.

13. A Perſon is to receive 275*l.* at 10 different Payments, each Payment to exceed the former by 5*l.* he is willing to beſtow the firſt Payment on any one that can tell him what it is: What muſt the Arithmetician have for his Pains?
14. Suppoſe it is 100 Leagues between London and Edinburgh, two Couriers ſet out from each Place on the ſame Road; that from London towards Edinburgh travelling every Day two Leagues more than the Day before; that from Edinburgh to ſet off one Day after the other, travelling every Day three Leagues more than the preceding one, and that they meet exactly

half Way, the firſt at the End of five Days, and the other at the End of four; how many Leagues did each travel per Day?

PROPOSITION VI.

When the firſt Term, Number of Terms, and the common Difference are given, to find the laſt Term.

RULE.

Subtract the common Difference from the Product of the Number of Terms, multiplied by the common Difference, the Remainder added to the firſt Term will give the laſt.

EXAMPLES.

15. What is the laſt Term of an Arithmetic Progreſſion, beginning at 6, and continuing by the Increaſe of 3 to 19 Places?
16. What is the laſt Term of an Arithmetic Progreſſion, beginning at 1, and continuing by the Increaſe of 2 to 100 Places?

PROPOSITION VII.

The firſt Term, common Difference, and Number of Terms being given, to find the Sum of all the Series.

RULE.

From the Product of the Number of Terms in the common Difference, ſubtract the common Difference, and to the Remainder, add the Double of the firſt Term; half the Product of that Sum multiplied by the Number of Terms, gives the Sum of all the Series.

EXAMPLE.

17. A Gentleman bargains with a Bricklayer to ſink him a Well 30 Yards deep, upon theſe Terms, viz. to pay him three Shillings for the firſt Yard, five for the ſecond, ſeven for the third, &c. raiſing two Shillings for every Yard: What will be due to the Bricklayer for completing the ſame?

PRO-

PROPOSITION VIII.

The firſt Term, the Number of Terms, and Sum of all the Terms being given, to find the common Difference.

RULE.

Divide the double Sum of all the Series by the Number of Terms, and from the Quotient ſubtract double the firſt Term; divide the Remainder by the Number of Terms leſſened by Unity, the Quotient will be the common Difference.

EXAMPLES.

18. A Gentleman travelled 200 Miles in eight Days, and every Day travelled equally farther than the preceding Day; it is known that the firſt Day he travelled ſix Miles: How many Miles did he travel each of the other Days?

19. A Perſon travelled from London to York, being 200 Miles, in 9 Days, and every Day travelled equally farther than the preceding Day; it is known that the firſt Day he travelled 4 Miles: How many Miles did he travel each of the other Days?

PROPOSITION IX.

When one Perſon or Thing moves with an equal, and another the ſame Way by a progreſſive Motion, to find what Time the firſt will be overtaken.

RULE.

To double the Space gone each Day by the purſued, add the common Difference of the Purſuer's Day's Journey, from that Sum ſubtract double the Space he travelled the firſt Day, and divide the Remainder by the common Difference, the Quotient will give the Number of Days, in which the Purſued will be overtaken by the Purſuer.

EXAMPLES.

20. A noted Highwayman having committed a Robbery, not ſuſpecting a Purſuit, fled Northward at the Rate

of nine Leagues a Day; one of Sir John Fielding's Men, upon the Scent, follows him in a progreſſive Motion, only three Leagues the firſt Day, five the ſecond, ſeven the third, and ſo on, increaſing every Day's Journey two Leagues: in how many Days will the Highwayman be overtaken?

21. Y. Z. made the following Bett for 1000 Guineas, to be decided the Monday, Tueſday, and Wedneſday, in Whitſun-Week, on Barham Downs, between the Hours of Eight in the Morning, and Eight at Night. The Propoſer has 10 choice Cricketters in full Exerciſe, who on this Occaſion are to be diſtinguiſhed by the firſt 10 Letters of the Alphabet. Theſe are to run and gather up, and carry ſingly 1000 Eggs, laid in a right Line, juſt two Yards aſunder, putting them gently into a Baſket placed juſt a Fathom behind the firſt. They are to work one at a Time, in the following Order: A. is to fetch up the firſt ten Eggs, B. the ſecond, C. the third ten, and ſo forward to K. whoſe turn it will be to fetch up the 100th Egg. After which A. ſets out again for the next 10, B. takes the next, and ſo forward alternately, till K. ſhall have carried up the 1000th Egg, at 100 Eggs per Man. The Fellows are to have 300*l.* for their three Days Work, if they do it, and it is to be diſtributed in Proportion to the Ground each Man ſhall in his Courſe have gone over; required, firſt, how many Miles each Perſon will have run? ſecondly, what Part of the 300*l.* will come to his Share? thirdly, whether, if the Men had been poſted at proper Places, they had not better have run from London to York twice, and back in the Time, taking the Meaſure at 180 Miles?

33. GEOMETRICAL PROGRESSION

Is when any Rank or Series of Numbers increaſe by one common Multiplier, or to decreaſe by one common Diviſor.

As 2 . 4 . 8 . 16 . 32 , 64 . Here the common Multiplier or Ratio is 2.

Alſo 729 . 243 . 81 . 27 . 9 . 3 . Here the common Diviſor or Ratio is 3.

In

In any Series of Numbers in Geometrical Progreſſion, the Product of the two Extremes are equal to the Product of any two Means that are equally diſtant from the Extremes.

As 3. 9. 27. 81. 243. 729.
Here $3\times729=27\times81=9\times243=2187$.

When the Number of Terms are odd, the middle Term multiplied into itſelf, will be equal to the Product of the two Extremes, or any two Means equally diſtant from the ſaid Mean or Middle Term.

As 3. 6. 12. 24. 48.
$12\times12=6\times24=48\times3=144$.

In Geometrical Progreſſion, the ſame five Things are to be obſerved, as in Arithmetical Progreſſion, viz.

1. The firſt Term.
2. The laſt Term.
3. The Number of Terms.
4. The Ratio.
5. The Sum of the Terms.

Any three of theſe being known, the Reſt may be found.

If to any Series of Numbers in Geometrical Proportion, when the firſt Term is not an Unit, or the ſame as Ratio, but not an Unit, and there be aſſigned a Series of Numbers in Arithmetical Progreſſion, beginning with an Unit or 1, and whoſe common Difference is 1, called Indices or Exponents.

Thus { 1.2.3. 4. 5. 6. 7. Indices.
{ 2.4.8.16.32.64.128. Number in Geometrical Progr.

The Addition or Subtraction of the Indices (or Numbers in Arithmetical Progreſſion) directly correſpond with the Product or Quotient of their reſpective Terms or Series in Geometrical Progreſſion.

That is { As $3+6=9$.
{ So $8\times64=512$ the 9th Term in : :

Again { As $6+6=12$.
{ So $64\times64=4092$ the 12th Term in : :

Or { As $6-3=3$.
{ So $64\div8=8$.

Or { As $7-2=5$.
{ So $128\div4=32$, &c.

But if the Series begin with Unity, or 1, the Indices muſt begin with a Cypher.

Thus

Thus { 0, 1, 2, 3, 4, 5, 6, 7, &c. Indices.
1, 2, 4, 8, 16, 32, 64, 128.

Now by theſe Indices, and a few of the firſt Terms, the laſt Term, or any diſtant one, may be ſpeedily found, without producing the whole Series.

PROPOSITION I.

When the firſt Term is Unity, the Ratio and Number of Terms being known, to find the laſt or any remote Term.

RULE.

Find a few of the leading Terms, over which place their Indices, as before directed, then find what Figures of the Indices, which added together will give the Index of the Term wanted, multiply the Numbers ſtanding under ſuch Indices into each other, and the laſt Product will be the Term required.

Note.—When the Indices begin with a Cypher, the Sum of the Indices made Choice of muſt be always one leſs than the Number of Terms given in Queſtion, as 1 in the Indices ſtands over the ſecond Term.

EXAMPLES.

1. A Boy agrees for 16 Oranges, to pay only the Price of the laſt, reckoning a Farthing for the firſt, an Halfpenny for the ſecond, &c. doubling the Price to the laſt. How much did he give for them?
2. A Man bought a Horſe, and by Agreement was to give what the laſt Nail would come to, at a Farthing for the firſt Nail, two for the ſecond, four for the third, &c. there were 4 Shoes, and 9 Nails in each Shoe: I demand the Price of the Horſe?

PROPOSITION II.

In any Series, not proceeding from Unity, the Ratio and firſt Term being given, to find any remote Term, without producing all the intermediate Terms.

RULE.

Proceed as in the laſt Propoſition, only obſerve to divide every

every Product by the firſt Term, and the Quotient will be the Term required.

EXAMPLES.

3. A Perſon dying left 11 Children, to whom and to his Executor he bequeathed in the manner following, viz. To his Executor, for ſeeing his Will performed, 10*l.* the youngeſt Child to have 30*l.* and ſo on every Child to exceed the next younger in triple Proportion: What will be the Share of the eldeſt?

4. A Nobleman dying left 10 Sons, to whom he left a certain Sum of Money to be divided among them, viz. the youngeſt Son to have 500*l.* the ſecond to have as much and half as much, and ſo on, every one to exceed the next younger in the ſame Ratio of $1\frac{1}{2}$. What is the Share of the eldeſt?

PROPOSITION III.

When the firſt Term, Ratio, and Number of Terms, are given, to find the Sum of all the Terms.

RULE.

Find the laſt Term as before, from which take the firſt, divide the Remainder by the Ratio, leſs one, and to that Quotient add the laſt Term, gives the Sum required.

EXAMPLES.

5. On New-Year's Day a Gentleman married, and received of his Father-in-law a Guinea, on Condition that he was to have a Preſent on the firſt Day of every Month for the firſt Year, which ſhould be double ſtill to what he had the Month before; what was the young Lady's Portion?

6. One, at a Country Fair, had a mind to a String of 20 fine Horſes; but not caring to take them at 20 Guineas per Head, the Jockey conſented that he ſhould, if he thought good, pay but a ſingle Farthing for the firſt, doubling it only to the 19th, and he would give the 20th into the Bargain: This being preſently accepted, how were they ſold per Head?

7. A

7. A Laceman, well verſed in Numbers, agreed with a Gentleman, to ſell him 20 Yards of rich Gold brocaded-Lace, for 2 Pins the firſt Yard, 6 for the ſecond, 18 for the third, and ſo on in triple Proportion; I demand how much the Lace produced, the Pins afterwards ſold at a Farthing per 100; alſo, whether the Laceman gained or loſt by the Sale thereof, ſuppoſing the ſaid Lace to have been bought at 8*l.* 1*s.* 8*d.* per Yard?

8. A cunning Servant agreed with a Maſter (unſkilled in Numbers) to ſerve him 11 Years without any other Reward for his Service, but the Produce of a Wheat-Corn for the firſt Year, and that Product to be ſown the ſecond Year, and ſo on from Year to Year, until the End of the Time, allowing the Increaſe to be but tenfold Proportion; I demand what the 11 Years Service came to, ſuppoſing the Sum of the whole Produce to be ſold at 4*s.* per Buſhel?

Note.—7680 Wheat Corns, round and dry out of the Middle of the Ear, are computed to fill a Statute Pint.

PROPOSITION IV.

Of any decreaſing Series in $\frac{\cdot\cdot}{\cdot\cdot\cdot}$, whoſe laſt Term is a Cypher, to find the Sum of thoſe Series.

RULE.

Divide the Square of the firſt Term by the Difference between the ſaid firſt Term, and the ſecond Term in the Series, the Quotient will be the Sum of the Series.

EXAMPLES.

9. A great Ship purſues a little one, ſteering the ſame Way, at the Diſtance of four Leagues from it, and ſails twice as faſt as the ſmall Ship. 'Tis aſked how far the great Ship muſt ſail before it overtakes the leſſer?

10. Suppoſe a Ball to be put in Motion by a Force which drives it 12 Miles the firſt Hour, 10 the ſecond, and ſo on continually decreaſing in Proportion of 12 to 10 to Infinity: What Space would it move through?

34. PERMUTATION, OR VARIATIONS,

Is the changing or varying the Order of Things, in reſpect of their Places.

RULE.

Multiply all the given Terms in a Series of Arithmetical Progreſſionals continually, whoſe firſt Term or common Difference is Unity or 1, and the laſt Term of the Number of Things propoſed to be varied together, and the laſt Product will be the Number of Changes or Variations required.

EXAMPLES.

1. Six Gentlemen that were travelling, met together by Chance at a certain Inn upon the Road, where they were ſo pleaſed with their Landlord, and each other's Company, that in a Frolic they made a contract to ſtay at that Place, ſo long as they, together with their Landlord, could ſit every Day in a different Order or Poſition at Dinner. Quere, the Time they ſtaid?
2. I demand the Number of Changes that may be rung on 12 Bells; alſo, in what Time may they all be rung, allowing 3 Seconds to every round, and 365 Days 6 Hours to the Year?
3. An Accomptant told a Gentleman, who had conſtantly 8 Perſons at his Table, that he would gladly make a ninth, and was willing to give 20 Guineas for his Board, ſo long as he could place the ſaid Company at Dinner, differently from any one Day before; this being accepted, what did his Entertainment coſt him per Year?

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TUTOR's GUIDE.

PART II.

35. VULGAR FRACTIONS.

A FRACTION is a Part or Parts of ſomething conſidered as an Unit or Integer, and conſiſts in two Parts or Quantities, one wrote over the other, with a Line between them, as $\frac{1}{4}$, $\frac{3}{5}$, $\frac{5}{28}$, &c.

The Number placed below the Line is called the Denominator of the Fraction, becauſe it denominates or ſhews how many Parts the Unit is broken or divided into, and the Number above the Line is called the Numerator, becauſe it enumerates or ſhews how many of thoſe Parts are contained in the Fraction.

A Vulgar Fraction is either proper, improper, compound, or mixed.

A proper Fraction, is when the Numerator is leſs than the Denominator, as $\frac{2}{3}$, $\frac{7}{8}$, $\frac{23}{36}$, $\frac{161}{215}$, &c.

An improper Fraction, is ſuch whoſe Numerator is equal to, or greater than its Denominator, as $\frac{2}{2}$, $\frac{12}{12}$, $\frac{247}{42}$, &c.

A compound Fraction, is the Fraction of a Fraction, and known by the Word of, as $\frac{3}{7}$ of $\frac{7}{8}$ of $\frac{4}{5}$, &c.

A mixed Number is compoſed of an whole Number and Fraction, as $4\frac{1}{4}$, $12\frac{7}{8}$, $142\frac{11}{12}$, &c.

36. REDUCTION of VULGAR FRACTIONS.

CASE I.

To reduce a Vulgar Fraction to its loweſt Terms.

RULE.

RULE.

Divide the greater Term by the leſſer, and that Diviſor by the Remainder following, till nothing remains; then by the laſt Remainder divide both Parts of the Fraction, and the Quotients will give the Fraction required: If the Remainder is 1, the Fraction is already in its leaſt Terms.

EXAMPLES.

1. Reduce $\frac{336}{896}$ to its leaſt Term.
2. Reduce $\frac{2832}{12848}$ to its loweſt Terms.
3. Reduce $\frac{144}{160}$ to its loweſt Terms.
4. Reduce $\frac{192}{336}$ to its loweſt Terms.
5. Reduce $\frac{1476}{19368}$ to its loweſt Terms.

When the Numerator and Denominator do each of them end with Cyphers, ſtrike off an equal Number of Cyphers in both, and the remaining Figures will be a Fraction of the ſame Value, which reduce to its loweſt Terms.

EXAMPLES.

6. Reduce $\frac{12000}{27000}$ to its loweſt Terms.
7. Reduce $\frac{4200}{54000}$ to its loweſt Terms.

When you diſcern any Number will equally divide both Numerator and Denominator, you may abbreviate the Fraction thereby.

8. Reduce $\frac{24}{112}$, $\frac{96}{324}$, $\frac{60}{144}$, and $\frac{120}{360}$ to their loweſt Terms.

CASE II.

To reduce a compound Fraction to a ſingle One.

RULE.

Multiply all the Numerators together for a new Numerator, and all Denominations for a new Denominator. Reduce the new Fraction to its loweſt Terms, by the laſt Caſe.

EXAMPLES.

8. Reduce $\frac{2}{3}$ of $\frac{1}{2}$, to a ſingle Fraction.
9. Reduce $\frac{4}{7}$ of $\frac{5}{7}$ of $\frac{9}{10}$, to a Single Fraction.
10. Reduce $\frac{2}{5}$ of $\frac{3}{4}$ of 4, to a Single Fraction.
11. Reduce $\frac{3}{7}$ of $\frac{1}{3}$ of $\frac{7}{8}$, to a ſingle Fraction.

CASE III.

To Reduce whole or mixed Numbers into an improper Fraction.

RULES.

1. If the whole Number has no aſſigned Denominator, an Unity ſubſcribed underneath, muſt be the Denominator.
2. If the whole Number has an aſſigned Denominator, multiply the whole Number by the aſſigned Denominator, and the Product will be the Numerator to the aſſigned Denominator.
3. If the whole Number has a Fraction annexed, multiply the whole Number by the Denominator of the Fraction, and to the Product add the Numerator for a new Numerator, which place over the Denominator.

EXAMPLES.

12. Reduce 12, 27, and 176, to Fractions.
13. Reduce 27 into a Fraction, whoſe Denominator ſhall be 12.
14. Reduce $4\frac{2}{7}$ to an improper Fraction.
15. Reduce $16\frac{1}{2}$ to an improper Fraction.
16. Reduce $142\frac{7}{23}$ to an improper Fraction.
17. Reduce $146\frac{21}{37}$ to an improper Fraction.

CASE IV.

To reduce an improper Fraction, into its equivalent or proper Terms.

RULE.

Divide the Numerator by the Denominator, the Quotient gives the whole Number, and under the Remainder (if any) ſubſcribe the Denominator.

EXAMPLES.

18. Reduce $\frac{30}{7}$ to its proper Terms.
19. Reduce $\frac{3}{2}$ to its proper Terms.
20. Reduce $\frac{328}{23}$ to its proper Terms.
21. Reduce $\frac{542}{27}$ to its proper Terms.

CASE

CASE V.

To reduce Fractions of different Denominations to Fractions of equal Value, that ſhall have one common Denominator.

RULE.

Multiply each Numerator (taken ſeparately) into all the Denominators but its own, and the Products will be the new Numerators: then multiply all the Denominators into one another for a common Denominator.

EXAMPLES.

22. Reduce $\frac{1}{4}$, $\frac{1}{12}$, and $\frac{7}{10}$, to a common Denominator.
23. Reduce $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$ of $\frac{7}{8}$, to a common Denominator.
24. Reduce $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$, to a common Denominator.
25. Reduce $\frac{5}{6}$, $\frac{7}{10}$, $\frac{3}{4}$, and $\frac{3}{4}$ of 3, to a common Denominator.

CASE VI.

To reduce Fractions of one Denomination to another, retaining the ſame Value.

RULES.

1. If the Fraction given is to be brought from a leſs to a greater Denomination; multiply the Denominator by the Parts contained in the ſeveral Denominations between it, and that you would reduce it to, for a new Denominator, which placed under the given Numerator, will give the new Fraction, which reduce to its loweſt Terms.

2. If the Fraction given is to be brought from a greater to a leſs Denomination, then multiply the Numerator in the ſame Manner as you did before the Denominator, and place over the given Denominator, and it will give the new Fraction, which alſo reduce to its loweſt Terms.

EXAMPLES.

26. Reduce $\frac{1}{4}$ of a Shilling to the Fraction of a Guinea.
27. Reduce $\frac{1}{240}$ of a £. to the Fraction of a Penny.
28. Reduce $\frac{1}{4}$ of a Farthing to the Fraction of a Moidore.

29. Reduce $\frac{5}{7}$ of a Penny to the Fraction of a £.
30. Reduce $\frac{1}{1343}$ of a Guinea to the Fraction of a Farthing.
31. Reduce $\frac{5}{6}$ of a dwt. to the Fraction of a lb. Troy.
32. Reduce $\frac{3}{4\frac{1}{7}}$ of a cwt. to the Fraction of a lb. Avoirdup.
33. Reduce $\frac{3}{4}$ of a Dram to the Fraction of a cwt.
34. Reduce $\frac{5}{143}$ of a lb. Troy to the Fraction of a dwt.
35. Reduce $\frac{7}{9}$ of a League to the Fraction of a Pole.
36. Reduce $\frac{7}{4\frac{1}{5}}$ of a Yard to the Fraction of a Nail.
37. Reduce $\frac{1}{1\frac{1}{2}}$ of a Gallon of Wine to the Fraction of a hhd.
38. Reduce $\frac{7}{9}$ of a hhd. of Ale to the Fraction of a Pint.
39. Reduce $\frac{7}{1\frac{7}{42}}$ of a Chaldron to the Fraction of a Bushel.
40. Reduce $\frac{2}{5}$ of a Gallon to the Fraction of a Chaldron.
41. Reduce $\frac{7}{1\frac{4}{5}}$ of a Week to the Fraction of a Second.
42. Reduce $\frac{9}{11}$ of a Minute to the Fraction of a Day.

CASE VII.

To find the proper Quantity or Value of a Fraction in Money, Weights, or Measures.

RULE.

Multiply the Numerator of the given Fraction, by the Parts contained in the Integer to which it belongs; then divide that Product by the Denominator, and if any Thing remains, reduce it to the next Denomination less, and divide again by the Denominator; thus proceed to the least Denomination.

EXAMPLES.

43. Reduce $\frac{3}{1}\frac{6}{2}\frac{7}{9}\frac{}{6}$ of a Moidore to its proper Quantity.
44. Reduce $\frac{5}{1\frac{5}{2}}$ of a Guinea to its proper Quantity.
45. Reduce $\frac{5}{8}$ of a Shilling to its proper Quantity.
46. Reduce $\frac{4}{5}$ of a Three-Pound-Twelve to its proper Quantity.
47. What is the Value of $\frac{5}{7}$ of a £.?
48. Reduce $\frac{4}{7}\frac{1}{2}\frac{1}{0}$ of a lb. Troy to its proper Quantity.
49. What is the Value of $\frac{7}{9}$ of a cwt.?
50. Reduce $\frac{6}{1}\frac{3}{2}\frac{3}{4}$ of a Ton to its proper Quantity.
51. What is the Value of $\frac{7}{8}$ of a Mile?
52. Reduce $\frac{5}{8}$ of an Ell English to its proper Quantity.
53. Reduce $\frac{7}{8}$ of an Acre to its proper Quantity.

54. What

54. What is the Value of $\frac{1}{2}\frac{1}{3}\frac{1}{2}$ of a hhd. of Wine?
55. Reduce $\frac{7}{9}$ of a Barrel of Beer to its proper Quantity.
56. Reduce $\frac{2}{7}\frac{1}{2}$ of a Chaldron of Coals to its proper Quantity.
57. What is the Value of $\frac{7}{8}$ of a Month?
58. Reduce $\frac{5}{7}$ of a Day to its proper Quantity.

CASE VIII.

To reduce Money, Weights, or Meaſures, into Fractions.

RULE.

Reduce the given Quantity to the loweſt Name mentioned for a Numerator; under which put the Number of thoſe Parts contained in an Unit of the Integer for a Denominator, then reduce the Fraction to its loweſt Terms.

EXAMPLES.

59. Reduce 6*s.* 8$\frac{1}{2}$*d.* to the Fraction of a Pound.
60. Reduce 4$\frac{1}{2}$*d.* to the Fraction of a Shilling.
61. Reduce 2*l.* 17*s.* 7$\frac{1}{5}$*d.* to the Fraction of a Three-Pound-Twelve.
62. Reduce 8*s.* 2*d.* to the Fraction of a Guinea.
63. Reduce 6oz. 17 dwts. 21 grs. to the Fraction of a lb. Troy.
64. Reduce 3 qrs. 3 lb. 1 oz. 12$\frac{5}{9}$ drs. to the Fraction of a cwt.
65. Reduce 10 cwt. 18 lb. 1 oz. $\frac{1}{3}\frac{1}{1}$ to the Fraction of a Ton.
66. Reduce 3 qrs. $\frac{1}{8}$, to the Fraction of an Ell Engliſh.
67. Reduce 2 f. 6 in. into the Fraction of a Yard.
68. Reduce 4 fur. 32 p. to the Fraction of a Mile.
69. Reduce 3 r. 2 p. to the Fraction of an Acre.
70. Reduce 42 gal. of Wine to the Fraction of a hhd.
71. Reduce 28 gal. of Beer to the Fraction of a Barrel.
72. Reduce 14 bu. 2 p. to the Fraction of a Chaldron.
73. Reduce 1 w. 3 d. 12 h. to the Fraction of a Month.
74. Reduce 243 d. 8 h. to the Fraction of a Year (allowing 365 Days to the Year.)

37. ADDITION of VULGAR FRACTIONS.

RULES.

1. Reduce the given Fractions to a common Denominator, by Caſe V. in Reduction.

2. Add all the Numerators together for a new Numerator, under which subscribe the common Denominator. And if it is an improper Fraction, reduce it to its proper Terms (by Case IV.) and you have the Sum of all the Fractions.

EXAMPLES.

1. Add $\frac{3}{7}$, $\frac{1}{4}$, and $\frac{5}{6}$, together.
2. Add $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{6}$, together.
3. Add $\frac{2}{3}$ of $\frac{4}{5}$, and $1\frac{3}{4}$, together.
4. Add $\frac{3}{7}$ of $\frac{5}{6}$, to $\frac{7}{9}$ of $\frac{3}{4}$.
5. Add $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$ of $\frac{5}{6}$, into one Sum.

2. To add mixed Numbers.

RULE.

Reduce the Fractions to a common Denominator, and add them together, as before directed, and annex their Sum, to the Sum of the Integers.

EXAMPLES.

6. Add $4\frac{1}{2}$ and $17\frac{3}{4}$ together.
7. Add $7\frac{2}{3}$, $9\frac{4}{5}$, and $6\frac{7}{16}$, together.
8. Add $8\frac{1}{2}$, $9\frac{2}{3}$, $10\frac{3}{4}$, $11\frac{4}{5}$, and $12\frac{5}{6}$, into one Sum.

3. When the given Fractions are of several Denominations.

RULE.

Reduce them to one Denomination (by Case VIII.) then add them together as before directed; or you may reduce them to their proper Quantities (by Case IX.) and add as in Sect. 9.

EXAMPLES.

9. Add $\frac{201}{4600}$ of a £. to $\frac{1}{8}$ of a Shilling.
10. Add $\frac{1}{4}$ of a lb. Troy, to $\frac{1}{3}$ of an oz.
11. Add $\frac{5}{8}$ of an cwt. to $\frac{1}{3}$ of a lb.
12. Add $\frac{1}{4}$ of a Yard, to $\frac{2}{5}$ of an Ell Eng.
13. To $\frac{5}{6}$ of a Mile, add $\frac{2}{3}$ of a Yard.
14. Add $\frac{3}{8}$ of a Chaldron, to $\frac{1}{2}$ of a Peck.
15. To $\frac{3}{4}$ of a Week, add $\frac{5}{6}$ of a Month.
16. Add $\frac{3}{4}$ of an Hour, to $\frac{5}{8}$ of a Week,

17. Add

17. Add $\frac{2}{5}$ of $12l.+4\frac{3}{7}l.+\frac{1}{5}$ of $\frac{9}{10}$ of a $l.+\frac{3}{5}$ of $\frac{5}{6}$ of a Shilling into one Sum.

38. SUBTRACTION of VULGAR FRACTIONS.

RULES.

1. Prepare the Fractions as before directed in Addition.

2. Subtract one Numerator from the other, and their Difference will be a new Numerator, under which, subscribe the common Denominator.

EXAMPLES.

1. It is required to subtract $\frac{2}{9}$ from $\frac{11}{12}$.
2. From $\frac{19}{64}$ take $\frac{2}{13}$.
3. From $\frac{14}{17}$ take $\frac{7}{11}$.
4. From $\frac{3}{4}$ of $\frac{7}{8}$ take $\frac{2}{5}$.
5. From $\frac{5}{6}$ of $\frac{7}{10}$ take $\frac{2}{3}$ of $\frac{1}{2}$.
6. From $10\frac{1}{4}$ take $6\frac{1}{6}$.
7. From $17\frac{1}{12}$ take $16\frac{6}{7}$.
8. From 12 take $\frac{5}{8}$ of $\frac{7}{8}$ of $\frac{3}{4}$.
9. From $\frac{2}{3}$ of a Shilling take $\frac{1}{4}$ of a Penny.
10. From $\frac{1}{5}$ of a cwt. take $\frac{3}{4}$ of an oz.
11. From $\frac{3}{4}$ of a Yard take $\frac{3}{8}$ of an Inch.
12. From $\frac{3}{8}$ of a Chaldron take $\frac{2}{3}$ of a Peck.
13. From $\frac{5}{6}$ of a Day take $\frac{3}{4}$ of an Hour.

39. MULTIPLICATION of VULGAR FRACTIONS.

RULES.

1. Prepare the Fractions to be multiplied, i. e. reduce compound Fractions to simple ones, per Case II. bring mixed Numbers into improper Fractions, per Case III. then reduce the Fractions into their lowest Terms.

2. Multiply the Numerators into one another for a new Numerator; and the Denominators into one another for a new Denominator. If the Fractions will cancel, do it as in Case II.

EXAMPLES.

EXAMPLES.

1. Mul. $\frac{6}{11}$ by $\frac{7}{12}$.
2. Mul. $12\frac{1}{2}$ by 6.
3. Mul. $17\frac{3}{7}$ by $\frac{7}{8}$.
4. Mul. $2\frac{1}{4}$ by $\frac{1}{4}$ of $\frac{7}{8}$.
5. Mul. $12\frac{3}{4}$ by $\frac{7}{8}$ of 12.
6. Mul. $\frac{3}{4}$ of $\frac{10}{11}$ by 6.
7. Mul. $\frac{7}{8}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of $\frac{5}{7}$ of 14.
8. Mul. $3\frac{2}{3}$ by $\frac{1}{7}$, and this Product again by $\frac{3}{5}$ of $\frac{3}{4}$.

40. DIVISION of VULGAR FRACTIONS.

RULES.

1. Prepare the Fractions as before directed in Multiplication.

2. Multiply the Numerator of the Dividend into the Denominator of the dividing Fraction, for a new Numerator, and multiply the other Numerator and Denominator together for a new Denominator, or invert the Divisor, and then proceed as in the last Rule.

EXAMPLES.

1. Divide $\frac{6}{7}$ by $\frac{3}{5}$.
2. Divide $\frac{2}{11}$ by $\frac{2}{3}$ of $\frac{7}{8}$.
3. Divide $12\frac{1}{2}$ by $17\frac{2}{3}$.
4. Divide $12\frac{3}{4}$ by $3\frac{7}{8}$.
5. Divide $\frac{7}{8}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of 12.
6. Divide $7\frac{2}{7}$ by 9.
7. Divide 96 by 146.
8. Divide $14\frac{3}{7}$ by $\frac{3}{4}$ of 12.
9. Divide $142\frac{7}{12}$ by $12\frac{3}{5}$.
10. Divide $\frac{7}{8}$ of 6 by $\frac{3}{4}$ of $\frac{6}{7}$ of $\frac{11}{12}$.

41. The RULE of THREE DIRECT.

In VULGAR FRACTIONS.

There are two Methods to perform this Rule, the second of which is the most expeditious and easiest.

RULES.

1. Prepare the Fractions, if required, as directed in Multiplication; then proceed as in Sect. 12.—Or,

2. Having reduced the Fraction, and stated the Question, as before directed,

3. Multiply the Denominator of your first Number into the Numerators of the second and third, for a new Numerator;

merator; then multiply the Numerator of the firſt Number into the Denominator of the ſecond and third, for a new Denominator, and place it under the new Numerator, for an Anſwer, which reduce to its proper Quantity; or invert the firſt Term, and then proceed as in Sect. 39.

EXAMPLES.

1. If $2\frac{2}{5}$ Yards of Silk coſt $3\frac{1}{4}$*l.* what will $4\frac{4}{5}$ Yards coſt at the ſame Rate?
2. If $\frac{3}{4}$ of a lb. coſt 5*s.* 6*d.* what will $42\frac{3}{8}$ lb. of the ſame coſt?
3. Suppoſe I give 14*s.* 8*d.* for $\frac{7}{9}$ cwt. what muſt be given for 8 cwt. of the ſame, at that Rate?
4. A Merchant makes an Aſſurance upon a Ship and Cargo, bound to a certain Port, Value 2700*l.* 10*s.* and agrees to pay 10 Guineas per Cent.; to what comes the Premium or Charges of the Aſſurance?
5. How much South Sea Stock, at $112\frac{1}{8}$*l.* per Cent. will 1270*l.* Purchaſe?
6. A Mercer bought $4\frac{3}{4}$ Pieces of Silk, each Piece containing $22\frac{3}{8}$ Yards, and was to give 8*s.* 9*d.* per Yard; I demand the Value of the Whole?
7. If I give 100*l.* 10*s.* 6*d.* for 12 Pieces of Holland, at the Rate of 5*s.* $6\frac{3}{4}$*d.* per Ell Flemiſh; I demand how many Ells Engliſh each Piece contained?

42. The RULE of THREE INVERSE,

In VULGAR FRACTIONS.

As I obſerved in the Rule of Three Direct, of there being two Methods of performing it, ſo likewiſe in this.

RULES.

1. Prepare the Fraction as before directed, and then proceed as in Sect. 13.—Or,

2. Multiply the Denominator of the third Number into the Numerator of the firſt and ſecond for a new Numerator; then multiply the Numerator of the third Number into the Denominator of the firſt and ſecond, for a Denominator, which place under the Numerator for an Anſwer, and find the proper Quantity as before; or invert the laſt Term, and proceed as in the laſt Rule.

EXAMPLES.

EXAMPLES.

1. A. lends B. $25\frac{1}{3}$ *l.* for $6\frac{3}{4}$ Months; how long ought B. to let A. have $10\frac{2}{3}$ *l.* to requite his Kindneſs?
2. If 4 Men can do a Piece of Work in $12\frac{1}{2}$ Hours, in how many Hours will 12 Men do the ſame?
3. If the Penny Loaf weighs $12\frac{2}{3}$ oz. when the Buſhel of Wheat is ſold for 5*s.* what is the Buſhel worth, when the Penny Loaf weighs $8\frac{1}{4}$ oz.?
4. Suppoſe A. lends to B. $100\frac{2}{3}$ *l.* for $6\frac{2}{3}$ Months, what Sum muſt B. lend A. for $3\frac{5}{6}$ Years to requite him?
5. How many Yards of Cloth at 8*s.* 6*d.* per Yard, muſt be given for $26\frac{2}{3}$ Yards, at 5*s.* 7*d.* per Yard?

43. The DOUBLE RULE of THREE.

In VULGAR FRACTIONS.

RULE.

Prepare the Number as before directed, and then proceed as in (17.)

EXAMPLES.

1. What Principal, put to Intereſt, will gain 4*l.* 15*s.* in 9 Months, at 6*l.* per Cent. per Annum?
2. Suppoſe 12 Students ſpent 14*l.* 6*s.* 8*d.* in 16 Days, how much will 18 Students ſpend in 34 Days?
3. If the Carriage of 40 cwt. 30 Miles, coſt 16*l.* 13*s.* 4*d.* What Weight may I have carried 80 Miles for 6*l.* 17*s.* 6*d.* at the ſame Rate?
4. Six Men with their Wives, upon Calculation, found that their Expences for three Months paſt (allowing 30 Days to one Month) amounted to 26*l.* 19*s.* 4*d.* I demand what Time 14*l.* 15*s.* may be ſpent by 36 Men in the like Proportion?
5. If 30 Men can perform a Piece of Work in eleven Days, how many will accompliſh another, four Times as big, in one fifth of the Time?
6. Agreed for the Carriage of $2\frac{1}{2}$ Tons of Goods, 3 Miles wanting $\frac{1}{10}$, for $\frac{1}{8}$ of $\frac{3}{5}$ of a Guinea: What was that per cwt. for a Mile?

QUESTIONS

QUESTIONS for EXERCISE in FRACTIONS.

1. Four Figures of nine may be ſo placed and diſpoſed of as to denote and read for 100, neither more nor leſs: Pray how is that to be done?
2. What Number is that, to which if $\frac{3}{10}$ of $\frac{18}{7}$ of $\frac{141}{213}$ be added, the Total will be 1?
3. What Number is that, from which if you deduct the $\frac{1}{25}$ of $\frac{7}{8}$, and to the Remainder add $\frac{1}{16}$ of $\frac{47}{19}$, the Sum will be 3?
4. What Number is that, to which if you add $\frac{1}{11}$ of 12, more $\frac{1}{15}$ of 27, and from the Total ſubtract $\frac{1}{3}$ of $7\frac{1}{2}$ of leſs $\frac{29}{30}$ of $1\frac{1}{4}$, the Remainder ſhall be 8?
5. There is a Number, which, if multiplied by $\frac{3}{4}$ of $\frac{7}{8}$ of $2\frac{1}{4}$, will produce no more than 1: What is the Cube of that Number?
6. There is a Number, which, if divided by $1\frac{2}{3}$ of $\frac{3}{10}$ will quote $9\frac{28}{37}$: Pray what is the Square of that Number?
7. If $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{7}{8}$ of a Ship be worth $\frac{1}{9}$ of $\frac{6}{7}$ of $\frac{15}{13}$ of the Cargo, Value at 1200*l.* what did both Ship and Cargo ſtand the Owners in?
8. A Perſon was poſſeſſed of a $\frac{3}{5}$ Share of a Copper Mine, and ſold $\frac{1}{4}$ of his Intereſt therein for 1710*l.* what was the reputed Value of the whole Property at the ſame Rate?
9. A Father deviſed $\frac{34}{83}$ of his Eſtate to one of his Sons, and $\frac{34}{83}$ of the Reſidue to another, and the Surplus to his Relict, for her Life; the Children's Legacies were found to be 257*l.* 3*s.* 4*d.* different: Pray what Money did he leave the Widow the Uſe of?
10. A Perſon making his Will, gave to one Child $\frac{19}{30}$ of his Eſtate, to another $\frac{11}{30}$, and when theſe Legacies came to be paid, one turned out 540*l.* 10*s.* more than the other: What did the Teſtator die worth?
11. A Lad having got 4000 Nuts, in his return home was met by Mad Tom, who took from him $\frac{5}{8}$ of $\frac{2}{3}$ of his whole Stock. Raving Ned lights on him afterwards, and forced $\frac{2}{5}$ of $\frac{5}{8}$ of the Remainder from him; unluckily, Poſitive Jack found him, and required $\frac{7}{10}$ of $\frac{17}{20}$ of what he had left. Smiling Dolly was, by promiſe, to have $\frac{3}{4}$ of a Quarter of what Nuts he brought home; how many then had the Boy left?

12. A

12. A younger Brother received 2200*l.* which was juſt $\frac{5}{12}$ of his elder Brother's Fortune; and 3 and $\frac{1}{8}$ Times the Elder's Money was $\frac{2}{3}$ as much again as the Father was worth; what was that?

13. In Diſtreſs at Sea, they threw out 17 hhds. of Sugar, worth 34*l.* per hhd. the Worth of which came up to but $\frac{4}{7}$ of the Indigo they caſt overboard; beſides which they threw out 13 Iron Guns worth 18*l.* 10*s.* a Piece; the Value of all amounted to $\frac{3}{4}$ of $\frac{9}{13}$ of that and the Ship and Loading: Pray what of the Value came into the Port?

14. If A. having $\frac{7}{8}$ of $\frac{3}{5}$ of the Half of a trading Sloop and Cargo, worth 16131*l.* $\frac{7}{10}$ ſells his Brother B. $\frac{3}{4}$ of $\frac{4}{7}$ of his Intereſt therein at prime Coſt; what did it coſt the Brother, and what did his Couſin, P. pay at the ſame Time for $\frac{9}{11}$ of the Remainder?

15. X. Y. and Z. can, working together, complete a Stair-Caſe in 12 Days; Z. is Man enough to do it alone in 24 Days, and X. in 84; in what Time then could Y. get it done himſelf?

16. A Father dying left his Son a Fortune, $\frac{3}{16}$ of which he ran through in ſix Months; $\frac{2}{3}$ of the Remainder held him a Twelvemonth longer, at which Time he had bare 348*l.* left: Pray what did his Father bequeath him?

17. Kitty told her Brother George, that though her Fortune on her Marriage took 19312*l.* out of the Family, it was but $\frac{3}{5}$ of 2 Years Rent. Heaven be praiſed for this Yearly Income! Pray what was it?

18. A merry young Fellow in a ſhort Time got the better of $\frac{1}{3}$ of his Fortune; by Advice of his Friends he then gave 2200*l.* for an Exempt's Place in the Guards; his Profuſion continued till he had no more than 880 Guineas left, which he found by computation was juſt $\frac{3}{26}$ Part of his Money, after the Commiſſion was bought: Pray what was his Fortune at firſt?

19. A Perſon dying, left his Wife with Child, and making his Will, ordered, that if ſhe went with a Son, $\frac{3}{5}$ of the Eſtate ſhould belong to him, and the Remainder to his Mother; and if ſhe went with a Daughter, he appointed the Mother $\frac{2}{3}$, and the Girl $\frac{1}{3}$: But it happened that ſhe was delivered both of a Son and Daughter; by which ſhe loſt in Equity 2000*l.* more than if it had been only

only a Girl: What would have been her Dowry had ſhe only had a Son?

20. A Ciſtern holds 103 Gallons, and being brim-full, has two Cocks to run off the Water: by the firſt of which, a three Gallon Pail will be filled in 60 Seconds, by the other in 75; in what Time will this Ciſtern be emptied through both theſe Apertures together, ſuppoſing the Efflux of the Water all the ſame?

21. A Politician having about him a certain Number of Crowns, ſaid, If $\frac{1}{2}+\frac{1}{3}+\frac{1}{6}$ of what he had, were added together, they would make juſt Wilkes's Number (45); how many Crowns had he about him?

22. A Gentleman has an Orchard of Fruit Trees, one half of the Trees bearing Apples, one fourth Pears, one ſixth Plumbs, and one twelfth of them bearing Cherries: How many Fruit Trees in all grow in the ſaid Orchard?

23. A School Maſter being aſked how many Scholars he had, anſwered, If I had as many, and $\frac{1}{2}$ as many, and $\frac{1}{4}$ as many, I ſhould have 99. How many had he?

24. In the Year I wrote this, if to my Age you add
$\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{5}$, (thereof), with $\frac{4}{5}$ more,
The Number 74 will then be had.
Ingenious Youths, my Age explore.

25. A. in a Scuffle, ſeized on $\frac{2}{3}$ of a Parcel of Sugar-Plums, B. catched $\frac{3}{8}$ of it out of his Hands, and C. laid hold on $\frac{3}{10}$ more; D. ran off with all A. had left, except $\frac{1}{7}$, which E. afterwards ſecured ſlily for himſelf; then A. and C. jointly ſet upon B. who, in the Conflict, ſhed $\frac{1}{2}$ he had, which were equally picked up by D. and E. who lay perdue. B. then kicked down C.'s Hat, and to work they all went anew for what it contained; of which A. got $\frac{1}{4}$, B. $\frac{1}{2}$, D. $\frac{2}{7}$, and C. and E. equal Shares of what was left of that Stock; D. then ſtruck $\frac{3}{4}$ of what A. and B. laſt acquired out of their Hands; they with Difficulty recovered $\frac{5}{8}$ of it in equal Shares again, but the other three carried off $\frac{1}{5}$ a piece of the ſame. Upon this they called a Truce, and agreed, that the $\frac{1}{3}$ of the Whole left by A. at firſt ſhould be equally divided among them: How much of the Prize, after this Diſtribution, remained with each of the Competitors?

THE

TUTOR's GUIDE.

PART III.

44. DECIMAL FRACTIONS.

A Decimal Fraction, is a Fraction whoſe Denominator is always Unity or 1, with one or more Cyphers: Thus, an Unit may be imagined to be equally divided into 10 Parts, and each of theſe into 10 more; ſo that by a continual Decimal Sub-diviſion, the Unit may be ſuppoſed to be divided into 10, 100, 1000, and ſo on without End, all being equal Parts, called tenth, hundredth, thouſandth Part of an Unit or 1.

In Decimal Fractions, the Figures of the Numerator are only expreſſed, the Denominator being omitted, becauſe it is always known to conſiſt of an Unit with ſo many Cyphers as there are Places in the Numerator.

A Decimal Fraction is diſtinguiſhed from an Integer with a Point or Comma prefixed, thus, ,5 wich ſtands for $\frac{5}{10}$, or $\frac{1}{2}$; ,75 for $\frac{75}{100}$, or $\frac{3}{4}$; ,2752 for $\frac{2752}{10000}$; and 12,005 for $12\frac{5}{1000}$, or $12\frac{1}{10}$, &c.

Cyphers at the Right Hand of a Decimal Fraction alter not its Value: for ,5 or ,50 or ,5000 is each of them the ſame Value, and are equal to $\frac{5}{10}$ or $\frac{1}{2}$; but Cyphers at the Left Hand, in a Decimal Fraction, decreaſe the Value in a tenfold Proportion, for ,05 is $\frac{5}{100}$, alſo, 0005 is $\frac{5}{10000}$, &c. all of which will plainly appear by the following

TABLE.

TABLE.

1	Units.
2	Tens.
3	Hundreds.
4	Thousands.
5	Tens of Thousands.
6	C. of Thousands.
7	Millions.

1	Parts of Ten.
2	Parts of one Hundred.
3	Parts of one Thousand.
4	Parts of ten Thousand.
5	Parts of one C. Thousand.
6	Parts of a Million.
7	&c.

By the above Table it alſo plainly appears, that as whole Numbers increaſe towards the Left Hand by a ten-fold Proportion, ſo Decimal Parts decreaſe towards the Right Hand by the ſame Proportion.

A finite Decimal is that which ends at a certain Number of Places; but an infinite is that which no where ends.

A circulating or recurring Decimal, is that wherein one or more Figures are continually repeated.

Thus 64,766666, &c. or 64,76̇, is called a ſingle circulate or recurring Decimal.

And 147,642642, &c. or 147,64̇2̇, is called a compound recurring Decimal.

Note.—In all Operations, if the Reſult conſiſts of ſeveral Nines, reject them, and make the next ſuperior Place a Unity more. Thus, for 17,1999 write 17,2; and for 12,99 write 13, &c.

45. ADDITION of DECIMALS.

1. Addition and Subtraction in Decimals, are performed after the ſame Manner as Sect. 2, 3, of whole Numbers, Care being taken that like Parts be placed under one another, and from their Sum or Difference cut off ſo many Decimal Parts as there are the moſt in any of the given Numbers.

EXAMPLES.

1. What is the Sum of ,0476, 21,476, ,0067, 64, 17,6, and ,20764?

2. Add ,427, 64,075, 27,6421, 10,8, ,0074, and 104, ,046842, together.
3. What is the Sum of ,274, ,076, ,64762, ,0706, ,47, ,007, and 968,42?

2d. To add Decimals, wherein there are ſingle Repetends.

RULE.

Make every Line end at the ſame Place, filling up the Vacancies by the repeating Digits, and annexing a Cypher or Cyphers to the finite Terms; then add as before; only increaſe the Sum of the Right Hand Row, with as many Units as it contains Nines, and the Figure in the Sum under that Place will be a Repetend.

EXAMPLES.

4. What is the Sum of 47,67$\dot{4}$, 4,02642, 32,$\dot{6}$, 6,1$\dot{4}$, and 27,0646?
5. Add 11,$\dot{4}$, 6,14274, 91,78, 37,67$\dot{7}$, and 146,476742.
6. What is the Sum of 14,276421, 7,$\dot{4}$, 21,64$\dot{6}$, 9,$\dot{2}\dot{7}$, and 31,1474?

3d. To add Decimals, having compound Repetends.

RULE.

Make the Repetends ſimilar and conterminous; then add as before, only increaſe the Right Hand Figure by as many Units as are carried from the Column of Figures, wherein all the Repetends begin together; laſtly, daſh off for a Repetend as many places as were ſo in the Numbers, added together.

EXAMPLES.

7. What is the Sum of 14,$\dot{2}47\dot{2}$, 768,$\dot{2}4\dot{6}$, 7,$\dot{9}6\dot{4}$, and 26,006$\dot{2}$?
8. Add ,$\dot{2}4\dot{6}$, 3,$\dot{6}\dot{7}$, 27,04$\dot{2}7694$, and 9,$\dot{9}4\dot{3}$, together.

46. SUBTRACTION of DECIMALS.

EXAMPLES.

1. What is the Difference between 176, and 10,764?

2. From

2. From 647, take ,00746.
3. What is the Difference between 74,6407, and 69,5?

2d. To ſubtract Decimals that have a ſingle Repetend.

RULE.

Make both end together as in Addition; and if the Repetend of the Number to be ſubtracted, be greater than the Repetend of the Number it is to be taken from, then the Right Hand Figure of the Remainder muſt be leſs by Unity than it would be; or inſtead of borrowing Ten, as in whole Numbers or Infinites, borrow in this Place 9, the reſt as uſual, and the Right Hand Place or Figure will be a Repetend.

EXAMPLES.

4. What is the Difference between 41,7$\dot{4}$, and 21,94648?
5. From 24,1466, take 19,$\dot{9}$.
6. What is the Difference between 16,1$\dot{2}\dot{6}$, and 4,1942764?

47. MULTIPLICATION of DECIMALS.

1ſt. Multiplication in Decimals is alſo performed as in whole Numbers, no Regard being had to the Decimals as ſuch, till the Product is obtained, then obſerve the following

RULES.

1. Strike off ſo many Figures from the Right Hand of the Product as there are Decimal Places in the Multiplier and Multiplicand.

2. But if there are not ſo many Figures in the Product, ſupply the Deficiency by prefixing Cyphers to the Left Hand to make them equal.

3. If the Number is to be multiplied by 10, 1000, &c. remove the ſeparating Point in the Multiplicand ſo many Places towards the Right Hand, as there are Cyphers in the Multiplier.

EXAMPLES.

1. Multiply ,17504, by 76.
2. Mul. 27,42, by 3,56.
3. Mul. 8,04704, by ,2575.
4. Mul. 5745, by ,0675.
5. Mul. ,4 by ,2.
6. Mul. ,047 by ,046.
7. Mul. ,0476 by ,02078.
8. Mul. ,47 by ,0008.
9. Mul. ,1076 by 1000.
10. Mul. ,42768 by 10000.

2d. When the Product will contain more Decimals than are neceſſary for the preſent Purpoſe, the Work may be contracted by the following

RULE.

Write down the Multiplicand as uſual, then write under it the Multiplier inverted, with the Unit Place thereof under that Place of the Multiplicand, whoſe Place you intend the Product ſhall extend to; then multiply as uſual, by each Figure of the Multiplier, beginning with thoſe of the Multiplicand which ſtand over it, neglecting thoſe to the Right Hand, unleſs ſo far as to obſerve what would ariſe from multiplying the Figures immediately foregoing, which muſt be taken in at the Beginning of each Line, the firſt Figure of each particular Product muſt ſtand underneath one another.

Note.—In multiplying the Figure left out every Time, next the Right Hand in the Multiplicand, if the Product be 5, or upwards to 15, carry 1; if 15, or upwards to 25, carry 2; and if 25, or upwards to 35, carry 3, &c.

EXAMPLES.

11. Let it be required to multiply 3,17678, by 276782, and to have only three Places of Decimals in the Product.
12. Multiply 47,689464 by 26,17694, retaining five Decimals in the Product.

3d. If the Right Hand Figure of the Multiplicand be a Circulate.

RULE.

Multiply the Multiplicand before, by every Figure in the Multiplier; obſerving to increaſe the Right Hand of each

each reſulting Line, by as many Units as there are Nines in the Product of the firſt Figure in that Line, and the right Hand Figure of each Line will be a Circulate; and before you add them together, make them all end at the ſame Place as ſhewn in Addition,

EXAMPLES.

13. Let it be required to multiply 147,64 by ,7.
14. Multiply 42,64$\dot{2}$ by ,276.

4th. When the right Hand Figure of the Multiplier be a Circulate.

RULE.

Multiply by, as by a finite Digit, ſetting the Product one Place extraordinary towards the left Hand; then divide the Product by 9, continuing the Quotient if needful, till it arrives at a Circulate; then beginning at the Place under the right Hand Figure of the Multiplicand, cut off for Decimal Parts.

EXAMPLES.

15. Multiply 46,2762 by ,8.
16. Let it be required to multiply 261,276 by ,47.

5th. When the Multiplicand and Multiplier are each a ſingle Circulate.

RULE.

The firſt Line (or that produced by multiplying the Circulate in the Multiplier) muſt be managed as in Note 2, only the right Hand Figure muſt be increaſed by as many Units as there are Nines in the Product of the Firſt Figure of that Line; the Product of the Reſt muſt be managed as directed in Note 1.

EXAMPLES.

17. Multiply 141,14 by 8,47.
18. Let it be required to multiply 24,607$\dot{2}$ by ,49$\dot{8}$.

6th. If the Multiplicand be a compound Repetend, and the Multiplier a finite Number.

RULE.

RULE.

In multiplying, obſerve to add to the right Hand Place of the Product, ſo many Units as there are Tens in the Product of the left Hand Place of the Repetend; and the Product ſhall contain a Repetend, whoſe Places are equal to thoſe in the Multiplicand, and if there be more Places of Figures in the Multiplier than one, make all the ſeveral Products conterminous towards the right Hand, (3. and 6th.)

EXAMPLES.

19. Multiply 7,64$\dot{2}$ by 6. 20. Multiply 64,84$\dot{2}$ by 27,9.

7th. If the Multiplier be a compound Repetend.

RULE.

Multiply each Figure of the Repetend, and add the ſeveral Products together, then add the Reſult in this Manner; ſet the left Hand Figure ſo many Places forward, as exceeds the Number of Places in the Repetend by one, and the Reſt of the Figures in Order after it; and thus proceed, till the Reſult laſt added is beyond the firſt; laſtly, add the ſeveral Reſults together, beginning under the right Hand Place of the firſt, and from thence daſh as many Figures for a Repetend, as the Repetend of the Multiplier conſiſts of.

EXAMPLES.

21. Mul. 46,74 by 4,$\dot{3}\dot{0}\dot{7}$. 22. Mul. 764,742 by $\dot{6}0\dot{7}\dot{4}$.

8th. If both Factors have compound Repetends.

RULE.

Proceed as in the two laſt Caſes; for as the Places of the Repetend in the Product will be uncertain as to their Number, they can only be determined (in any Manner fit for Practice) by continuing and repeating the firſt Product, which will contain a certain Repetend, equal to that of the Multiplicand.

EXAMPLES.

EXAMPLES.

23. Mul. 47,642 by 3,674. 24. Mul. 7,628 by 8,495.

48. DIVISION of DECIMALS.

In Diviſion of Decimals, the Work is likewiſe performed as in Whole Numbers; the only Difficulty is in valuing the Quotient, which will be very eaſy by obſerving either of the following general

RULES.

1. The firſt Figure in the Quotient is always of the ſame Value with that Figure of the Dividend, which anſwers or ſtands over the Place of Units in the Diviſor.

2. The Quotient muſt always have ſo many Decimal Places, as the Dividend has more than the Diviſor.

EXAMPLES.

1. Divide 1735,5 by 6,5.
2. Divide ,8332 by ,0084.
3. Divide 186,9 by 7,476.
4. Divide 6 by ,008.
5. Div. 246,1476 by 604,25.
6. Divide 7,268401 by 119.
7. Divide 6,7258 by 647.
8. Divide ,0008136 by 678.
9. Divide 487,67 by 1000.
10. Divide 4746 by 10000.

2*d*. There is alſo a compendious Way of contracting the Work, reverſe to that in Page 162, by which much Labour is ſaved, eſpecially when the Diviſor hath many Places of Decimal Parts in it; and is performed by the following

RULE.

By the firſt Rule find what is the Value of the firſt Figure in the Quotient; then, by knowing the Denomination of the firſt Figure, the Decimal Places may be reduced to any Number propoſed, by taking as many of the left Hand Figures of the Dividend as will anſwer them, and in dividing, omit, or prick off one Figure of the Diviſor at each Operation, that is, for every Figure you place in the Quotient, prick off one in the Diviſor; having a due Regard to the Increaſe which would ariſe from the Figure ſo omitted. (See Note in Page 166.)

EXAMPLES.

EXAMPLES.

11. Divide 913,08 by 2137,2, and let the Quotient only contain three Decimal Places.
12. Divide 6109,2674 by 240,649, and let there be only four Places of Decimals in the Quotient.

3d. When the Dividend is a ſingle or compound Repetend.

RULE.

If it be a ſingle Repetend, bring down the circulating Figure, until the Quotient either repeats, or is as exact as required; but if the Repetend in the Dividend be a compound one, then bring down the circulating Figures in the ſame Order they ſtand in; and when you have got through them all, bring down the firſt Figure in the Repetend over again, and ſo proceed until your Quotient either repeats, or be as exact as neceſſary.

EXAMPLES.

13. Divide 14,4 by 6,84.
14. Let it be required to divide 1694,847 by 46,849.

4th. If the Diviſor be a ſingle Repetend.

RULE.

Place the Dividend under itſelf, but removed one Place towards the right Hand, which ſubtract, and the Remainder will be a new Dividend; which Divide by the Diviſor in the ſame Manner, as if it was a terminate Number.

EXAMPLES.

15. Divide 42,86 by 8.
16. Divide 6,426 by 6,8.

5th. If the Diviſor and Dividend conſiſt of terminate Numbers joined to the Repetend.

RULE.

R U L E.

Place the Divisor and Dividend under each other, but removed one Place towards the right Hand; then subtract the Lower Lines: From the Upper, the Remainder will be a new Divisor and Dividend, which proceed with as before directed.

E X A M P L E S.

17. Divide 81869,8694 by 7414,864.
18. Divide 9,46946 by 64,842.

6th. If a compound Repetend is found in your Divisor, or in both your Divisor and Dividend.

R U L E.

Proceed as in the last Case with your Divisor and Dividend, only remove them each so many Places towards the right Hand, as they have Places in the Repetend of the Divisor; but if the Divisor is a compound Repetend without any terminate Figures, divide by it as a terminate Number; first subtracting the Dividend from itself, as above directed.

E X A M P L E S.

19. Divide 147,42683 by 8,467.
20. Divide 4176,4262268 by 37,26974.

49. REDUCTION of DECIMALS.

1. To reduce a Vulgar Fraction to a Decimal.

Add Cyphers to the Numerator, and divide by the Denominator, the Quotient will be the Decimal Fraction required.

EXAMPLES.

EXAMPLES.

1. Reduce $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, to Decimals.
2. Reduce $\frac{1}{2\,4}$ to a Decimal.
3. Reduce $\frac{5}{1\,2}$ of $\frac{1}{4}$ to a Decimal.
4. Reduce $\frac{4}{7}$ to a Decimal.
5. Reduce $\frac{2}{3}$ to a Decimal.
6. Reduce $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{7}{8}$ to a Decimal.
7. Reduce $\frac{1}{4}$ of $\frac{5}{1\,2}$ to a Decimal.

2. To reduce Coins, Weights, Meaſures, &c. into Decimals.

RULE I.

Reduce the given Money, Weights, &c. into the loweſt Denomination or Name mentioned, for a Dividend; then reduce the integer into the ſame Denomination for a Diviſor, the Reſult will be the Decimal required.

RULE II.

Write the given Denomination or Parts orderly under each other, the inferior or leaſt Parts being uppermoſt; let theſe be the Dividends. Againſt each Part on the Left Hand, write the Number thereof contained in one of its ſuperior; let theſe be Diviſors. Then beginning with the loweſt Denomination with Cyphers added (making a Dot between the Cyphers and the Figure) and divide, writing the Quotient of each Diviſor as Decimal Parts on the Right Hand of the Dividend next below it: and let this mixt Number be divided by its Diviſor, and ſo on, till all be finiſhed, and the laſt Quotient will be the Decimal required.

RULE III.

To reduce Shillings, Pence, and Farthings; if the Number of Shillings be even, take Half for the firſt Place of Decimals, and let the ſecond and third Place be filled up with the Farthings contained in the remaining Pence and

and Farthing, always remembering to add 1, when they are 25; if 40 add 2: But if the Number of Shillings be odd, multiply them by 5, and proceed with the Pence and Farthings as before.

EXAMPLE.

1. Reduce 17*s.* 6¾*d.* to the Decimal of a Pound.
2. Reduce 6*s.* 9*d.* to the Decimal of a £.
3. Reduce 9*s.* to the Decimal of a Guinea.
4. Reduce 14*s.* 6¾*d.* to the Decimal of a Moidore.
5. Reduce 18*s.* 4½*d.* to the Decimal of a £.
6. Reduce ¾ of a Penny to the Decimal of a £.
7. Reduce 11 dwts. to the Decimal of a lb. Troy.
8. Reduce 10 Drams to the Decimal of a lb. Avoirdupoise.
9. Reduce 3 qrs. 14 lb. to the Decimal of a cwt.
10. Reduce 6 Inches to the Decimal of a Yard.
11. Reduce 6 Furlongs to the Decimal of a League.
12. Reduce 18 gall. 2 qts. of Wine to the Decimal of a Tun.
13. Reduce 3 qrs. 1 pt. of Ale to the Decimal of a Barrel.
14. Reduce 8 Perches to the Decimal of an Acre.
15. Reduce 4 Bushels 2 Pecks to the Decimal of a Chaldron.
16. Reduce 12 Minutes to the Decimal of an Hour.
17. Reduce 12 Days to the Decimal of a Year (Julian).

By this Rule, the following Decimal Tables are made.

Decimal Tables of Coin, Weight, and Measure.

TABLE I.

Coin.

1 £. Ster. the Integ.

Sh.	dec.	Sh.	dec.
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence.	Decimals.
11	,045833
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,00416

Farth.	Decimals.
3	,003125
2	,002083
1	,001042

TABLE II.

Troy Weight.

1 lb. the Integer.

Ounces	Decimals.
11	,916666
10	,833333
9	,75
8	,666666
7	,583333
6	,5
5	,416666
4	,333333
3	,25
2	,166666
1	,083333

Note. This table of Oz. will alſo ſerve for Inches, Months, or Doz.

Penny weight.	Decimals.
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Grains	Decimals.
20	,003472
10	,001736
9	,001562
8	,001389
7	,001215
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173
½	,000086

TABLE III.

Avoirdupoise.

112 lb. the Integ.

Quart.	Decimals.
1	,75
2	,5
3	,25

Pounds	Decimals.
20	,178571
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Ounces	Decimals.
10	,00558
9	,005022
8	,004464
7	,003906
6	,003348
5	,00279
4	,002232
3	,001673
2	,001116
1	,000558

Drams	Decimals.
10	,000348
9	,000313
8	,000279
7	,000244
6	,000209
5	,000174
4	,000139

Decimal TABLES of COIN, WEIGHT, and MEASURE.

3	,000104
2	,000069
1	,000034
½	,000017

TABLE IV.

AVOIR. WEIGHT.

1 lb. the Integer.

Ounces.	Decimals.
8	,5
7	,4375
6	,375
5	,3125
4	,25
3	,1875
2	,125
1	,0625

Drams	Decimals.
8	,03125
7	,027343
6	,023427
5	,019531
4	,015625
3	,011718
2	,007812
1	,003906

TABLE V.

LIQUID MEASURE

1 Tun the Integer.

Gallons.	Decimals.
100	,396825
90	,357141
80	,317462
70	,27
60	,238095
50	,198412
40	,15873
30	,119047
20	,079365
10	,039682
9	,035714
8	,031746
7	,027
6	,023809
5	,019841
4	,015873
3	,011904
2	,007936
1	,003968

Pints.	Decimals.
4	,001984
3	,001488
2	,000992
1	,000496

A Hogshead the Integer.

Gallons.	Decimals.
30	,47619
20	,31746
10	,15873
9	,142857
8	,126984
7	,111111
6	,095238
5	,079365
4	,063492
3	,047619
2	,031746
1	,015873

Pints.	Decimals.
3	,005952
2	,003968
1	,001984

TABLE VI.

MEASURE.

Liquid. Dry.

Gallon. 1 *Quarter.* Integer.

Lnt.	Decim.	ush.
4	,5	4
3	,375	3
2	,25	2
1	,125	1

Q. p.	Decim.	Peck.
3	,09375	3
2	,0625	2
1	,03125	1

Decimals.	Q. Pk.
,023432	3
,025615	2
,026812	1

Decimals.	Pints.
,005859	3
,003900	2
,001053	1

TABLE VII.

LONG MEASURE.

1 Mile the Integer.

Yards.	Decimals.
1000	,568182
900	,511364
800	,454545
700	,397727
600	,340909
500	,284091
400	,227272
300	,170454
200	,113636
100	,056818
90	,051136
80	,045454
70	,039773
60	,054091
50	,028409
40	,022727
30	,017045
20	,011364

Decimal Tables of Coin, Weight, and Measure.

10	,005682
9	,005114
8	,004545
7	,003977
6	,003409
5	,002841
4	,002273
3	,001704
2	,001139
1	,000568

Feet.	Decimals.
2	,0003787
1	,0001894

Inch.	Decimals.
6	,0000947
5	,0000474
2	,0000315
1	,0000158

TABLE VIII.

TIME.

1 Year the Integer.

Days.	Decimals.
300	,821918
200	,547945
100	,273963
90	,246575
80	,219178
70	,191781
60	,164383
50	,136986
40	,109589
30	,082192
20	,054794
10	,027397
9	,024657
8	,021918
7	,019178
6	,016438
5	,013699
4	,010959
3	,008219
2	,005479
1	,002739

1 Day the Integer.

Hours.	Decimals.
20	,833333
10	,416666
9	,375
8	,333333
7	,291666
6	,25
5	,208333
4	,166666
3	,125
2	,083333
1	,041666

Minutes.	Decimals.
50	,034722
40	,027777
30	,020833
20	,013888
10	,006944
9	,00625
8	,005555
7	,004861
6	,004166
5	,003472
4	,002777
3	,002083
2	,001388
1	,000694

TABLE IX.

CLOTH MEASURE.

1 Yard the Integer.

Quarts.	Decimals.
3	,75
2	,5
1	,25

Nails.	Decimals.
3	,1875
2	,125
1	,0625

TABLE X.

LEAD WEIGHT.

1 Fother the Integ.

Hund.	Decimals.
10	,512857
9	,461538
8	,410256
7	,358974
6	,307692
5	,25641
4	,205128
3	,153846
2	,102564
1	,051282

Qrs.	Decimals.
2	,025641
1	,012821

Pounds	Decimals.
14	,0064102
13	,0059523
12	,0054945
11	,0050366
10	,0045787
9	,0041208
8	,0036630
7	,0032051
6	,0027472
5	,0022893
4	,0018315
3	,0013736
2	,0009157
1	,0004578

CASE III.

To find the Value of any Decimal Fraction, in Money, Weight, Measure, &c.

RULE.

Multiply the Decimal by the Number of Parts of the next inferior Denomination, cutting off so many Places for Decimals to the Right Hand, as your given Decimal consists of, and those on the Left will be Integers; then multiply the remaining Decimals by the next inferior Denomination, and cut off for Decimals as before; thus proceed till you have brought it into the least Parts of the Integer.

EXAMPLES.

1. What is the Value of ,878125 of a Pound Sterling?
2. What is the Value of ,3375 of a £.?
3. What is the Value of ,45 of a Guinea?
4. What is the Value of ,72708 of a Moidore?
5. What is the Value of ,00243 of a lb. Troy?
6. What is the Value of ,3375 of a Ton?
7. What is the Value of ,0396 of a lb. Avoirdupoise?
8. What is the Value of ,875 of a cwt.?
9. What is the Value of ,16669 of a Yard?
10. What is the Value of ,259 of a League?
11. What is the Value of ,29365 of a hhd. of Wine?
12. What is the Value of ,875 of a Barrel of Ale?
13. What is the Value of ,05 of an Acre?
14. What is the Value of ,125 of a Chaldron of Coals?
15. What is the Value of ,4765 of a Day?

59. EXTRACTION of the SQUARE ROOT.

Extracting the Square Root, is to find out such a Number as being multiplied into itself, the Product will be equal to the given Number.

As the Square Root of 81 is 9, consequently $9 \times 9 = 81$ the given Number.

Roots.	1	2	3	4	5	6	7	8	9
Squares.	1	4	9	16	25	36	49	64	81

To extract the Square Root of any Number, obſerve the following

RULES.

1. Point the given Number or Reſolvend into Periods of two Figures each, beginning at the Units Place.

2. Find by the Table the greateſt Square Number that is contained in the firſt Period towards the Left-hand, placing the Square Number under the firſt Period, and the Root thereof in the Quotient (as in Diviſion), ſubtract that Square out of the ſaid Period, and to the Remainder bring down the next Period for a Dividend.

3. Double the Quotient or Root, and place it for a Diviſor, ſeek how often the Diviſor is contained in the Dividend (reſerving always the Unit's Place), and put the Anſwer in the Quotient, and alſo on the Right Hand of the Diviſor: Then Multiply the Diviſor by the laſt Figure put in the Quotient (as in common Diviſion), the Product ſubtract from the Dividend, and to the Remainder bring down the next Period, which proceed with as before.

Note 1. But if it happens that the given Reſolvend is not a perfect Square, Cube, &c. then ſomething will remain after Extraction: hath been made throughout all the Points: When this is the Caſe, you muſt annex Cyphers according as the propoſed Power requires, viz. by Pairs or Two's in the Square; Three's in the Cube, &c. and the Operation continued as before.

2. If the given Reſolvend conſiſts of a whole Number and Decimals together, make the Number of Decimals even by adding Cyphers to them.

EXAMPLES.

1. Let it be required to extract the Square Root of 74770689.
2. What is the Square Root of 60516?
3. What is the Square Root of 7658?
4. What is the Square Root of 39342864?
5. What is the Square Root of 8209667940,625?
6. What is the Square Root of ,000725?
7. What is the Square Root of 2?
8. What is the Square Root of 2,2710657?
9. What is the Square Root of 36,00000625?

To

To extract the SQUARE ROOT of VULGAR FRACTIONS.

RULE.

Reduce the Fraction or Fractional Parts to its lowest Terms, and if it be a mixed Number, to an improper Fraction; then extract the Square Root of the Numerator for a new Numerator, and the Square Root of the Denominator for a new Denominator.

EXAMPLES.

1. What is the Square Root of $\frac{25}{81}$?
2. What is the Square Root of $\frac{225}{324}$?
3. What is the Square Root of $10\frac{39}{49}$?
4. What is the Square Root of $27\frac{9}{16}$?

SURDS.

To extract the Square Roots of Vulgar Fractions, when they be Surds, i. e. a Number where a Root can never be exactly found.

RULE.

Reduce the Fraction or Fractional Parts to its lowest Terms, then reduce it to a Decimal, and annex that Decimal to the Whole Number (if any) and extract the Square Root therefrom.

EXAMPLES.

5. What is the Square Root of $\frac{89}{4}$?
6. What is the Square Root of $\frac{597}{676}$?
7. What is the Square Root of $76\frac{14}{17}$?

51. The USE of the SQUARE ROOT.

CASE I.

To find a mean Proportion between any two given Numbers.

RULE.

RULE.

Multiply the two given Numbers together, and extract the Square Root of the Product, which Roots will be a mean Proportional ſought.

EXAMPLES.

1. What is the mean Proportional between 4 and 9?
2. What is the mean Proportional between 16 and 36?

CASE II.

To find the Side of a Square equal in Area to any given Superficies.

RULE.

Extract the Square Root of the given Superficies, which Root will be the Side of the Square ſought.

EXAMPLES.

3. If the Area of a given Circle is 4276,5, I demand the Side of a Square, whoſe ſuperficial Content ſhall be equal thereto?
4. Suppoſe I have an elliptical or irregular Fiſh-Pond, containing in Surface 9 Acres, 2 Roods, 15 Perches, and would have a ſquare one of the ſame Content; I deſire you'd tell how many Yards each Side muſt be?
5. If the Content of a given Circle be 160, what is the Side of a Square equal thereto?

CASE III.

Having the Area of a Circle, to find the Diameter.

RULE.

As 355 : 452 : : or, as 1 : 1,273239 : : ſo is the Area to the Square of the Diameter: or multiply the Square Root of the Area by 1,12837, and the Product will be the Anſwer. (See Problem VI. in Menſuration.)

EXAMPLES.

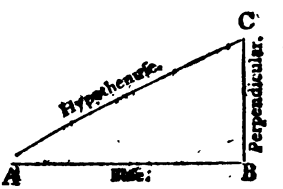
EXAMPLES.

6. Required the Diameter of a Circle that will comprehend within its Circumference, the Quantity of an Acre of Land.

7. In the Midſt of a Meadow well ſtored with Graſs,
I took juſt two Acres to tether my Horſe;
How long muſt the Cord be, that feeding all round,
He mayn't graze leſs or more than theſe two Acres of Ground?

CASE IV.

Any two Sides of a right-angled Triangle, A B C, being given, to find the remaining Side.



1. The Baſe and Perpendicular being given, to find the Hypothenuſe.

RULE.

Square each Side, add the Squares together, and the Square Root of this Sum gives the Hypothenuſe required.

2. If the Hypothenuſe and one Side be given, to find the other Side.

RULE.

From the Square of the Hypothenuſe, ſubtract the Square of the given Side, the Square Root of the Remainder gives the Side required.

EXAMPLES.

8. At Matlock, near the Peak in Derbyſhire, where are many ſurpriſing Curioſities in Nature, is a Rock by the Side of the River Derwent, riſing perpendicular to

to a wonderful Height, which being inacceſſible, I endeavoured to meaſure, and found by a mathematical Method, that the Diſtance between the Place of Obſervation and the Foot of the Rock to be 55½ Yards, and from the Top of the Rock to the ſaid Place to be 140½ Yards (nearly), required the Height of this ſtupendous Work?

9. A Ladder 40 Feet long may be ſo planted, that it ſhall reach a Window 33 Feet from the Ground on one Side the Street; and, without moving it at the Foot, will do the ſame by a Window 21 Feet high on the other Side; the Breadth of the Street is required?

10. A Line 27 Yards long, will exactly reach from the Top of a Fort, on the oppoſite Bank of a River, known to be 23 Yards broad: The Height of the Wall is required?

11. Suppoſe a Light-Houſe built on the Top of a Rock, the Diſtance between the Place of Obſervation and that Part of the Rock level with the Eye, and directly under the Building, is given 310 Fathoms; the Diſtance from the Top of the Rock to the Place of Obſervation is 423 Fathoms; and from the Top of the Building 425: The Height of the Edifice is required?

12. Two Ships ſet ſail from the ſame Port, one of them ſails due Eaſt 50 Leagues, the other due North 84: How far are they aſunder?

QUESTIONS for Exerciſe at leiſure Hours.

13. The Height of an Elm, growing in the Middle of a circular Iſland 30 Feet in Diameter, plumbs 53 Feet, and a Line, ſtretched from the Top of the Tree ſtraight to the hither Edge of the Water, 112 Feet: What then is the Breadth of the Moat, ſuppoſing the Land on the other Side the Water to be level?

14. Require the Length of a Shoar, that being to ſtrut 11 Feet from the Upright of a Building, will ſupport a Jamb 23 Feet 10 Inches from the Ground?

15. There are two Columns, in the Ruins of Perſepolis, left ſtanding upright, one is 64 Feet above the Plane, the other 50: Between theſe, in a right Line, ſtands an

an ancient Statue, the head whereof is 97 Feet from the Summit of the higher, and 86 Feet from the Top of the lower Column; the Base whereof measures just 76 Feet to the Center of the Figure's Base: By these Notices, the Distance of the Top of the Colomn may be, by Numbers, easily found.

16. A Castle Wall there was, whose Height was found
To be an Hundred Feet from th' Top to th' Ground;
Against the Wall a Ladder stood upright,
Of the same Length the Castle was in Height.
A waggish Youth did the Ladder Slide,
(The Bottom of it) ten Feet from the Side:
Now I would know how far the top did fall,
By pulling out the Ladder from the Wall?

17. As I was walking out one Day,
Which happened on the first of May,
As Luck would have it, I did spy
A May-Pole raised up on high,
The which at first me much surpris'd,
Not being before-hand advertis'd
Of such a strange uncommon sight;
I said I would not stir that Night,
Nor rest content until I'd found
Its Height exact from off the Ground;
But when these Words I just had spoke,
A Blast of Wind the May-Pole broke,
Whose broken Piece I found to be
Exact in Length Yards sixty-three,
Which by its Fall broke up a Hole,
Twice fifteen Yards from off the Pole;
But this being all that I can do,
The May-Pole now being broke in two
Unequal Parts, to aid a Friend,
Ye Youths, pray then an Answer send.

CASE V.

Any Number of Men being given, to form them into square Battle, or to find the Number of Ranks and Files.

RULE.

Extract the Square Root of the Number of Men given, will give the Number of Men either in Rank or File.

EXAMPLE.

EXAMPLE.

18. A General diſpoſing his Army into a ſquare Battle, finds he has 23716 Men; required the Number in Rank and File.

52. The EXTRACTION of the CUBE ROOT.

To extract the Cube Root, is to find out a Number, which being multiplied into itſelf, and then again into the Product, produceth the given Number.

As the Cube Root of 729 is 9, conſequently $9\times9\times9=729$ the given Number, and ſo of others, as in the following Table.

Roots.	1	2	3	4	5	6	7	8	9
Cube.	1	8	27	64	125	216	343	512	729

RULES.

1. Make a Point over every third Figure given, beginning at the Unit's Place, ſeek the greateſt Cube to the firſt Point on the Left Hand (by the Table) whoſe Root, place in the Quotient, then ſubtract its Cube from the Period, and to the Remainder (if any) bring down the three Figures, or your next Period, and call it your Dividend.

2. Find a Diviſor by calling your Quotient Figure, with a Cypher joined to it *r*; then three Times the Square of *r* will be your Diviſor; ſeek how often it is contained in the Dividend, and put the Anſwer in the Quotient as in Diviſion, only with this Difference: call the ſaid Quotient Figure laſt put up *e*, and multiply your Diviſor by it, and place the Produce underneath the Dividend, then multiply the Square of *e*, by three Times *r*, and place it alſo under the Dividend; laſtly, cube the Figure you called *e*, and place it under the Dividend: then add the three Products together, gives the Subtrahend, which ſubtract from your laſt Dividend, and to the Remainder, bring down the next Period, and proceed as before.

EXAMPLES.

EXAMPLES.

1. What is the Cube Root of 210246576?
2. Extract the Cube Root of 9239867.
3. What is the Cube Root of 2716243264?
4. What is the Cube Root of 91?
5. What is the Cube Root of 675278342397
6. Extract the Cube Root out of 4764,75.
7. The Solidity of a Cube is 36155,027576 Inches, what is the Side of that Cube?
8. What is the Side of that Cube, which contains 67667,921875 ſolid Inches?
9. What is the Cube Root of 21936329?
10. What is the Cube Root of 3105926,917?
11. What is the Cube Root of ,000421875?
12. What is the Side of a Cube, whoſe Solidity is 28022810,390625?

The Biquadrate of any Number is found, by extracting the Square Root of the given Number firſt, and then the Square Root of that Root.

13. Let it be required to extract the Biquadrate of 4857532416.

The Root of the Square cubed, or ſixth Power of any Number, is found by extracting the Square Root of the given Number, then extract the Cube Root of that Square Root, which will give the ſixth Power required.

14. Let it be required to extract the Square cubed Root of 49656.

The Root of the Biquadrate ſquared, or eighth Power, is found by firſt extracting the Square Root of the given Number, which will reduce it to a Biquadrate, which proceed with as before directed.

15. Let it be required to extract or find the Root of the eighth Power out of 43046721.

The Root of the Cube cubed, or ninth Power of any Number, is found by extracting the Cube Root of the given Number, and the Reſult will be a cubic Reſolvend, or extract the Cube Root alſo, which will be the Root of the ninth Power.

16. Let it be required to extract or find the Root of the ninth Power of 387420489.

The extraction of the first and second Surfolids, i. e. the fifth and seventh Powers, will prove too difficult a Task in common Numbers; I would therefore advise the Tutor to teach his Pupils only the Square and Cube Roots here, as they are the most useful, and, in short, as high as is required in all common Things. Besides, the Reason of the Thing cannot be shewn till the Pupil comes to the Algebraic Part, where it will be easily performed, and appear more evident.

To extract the CUBE ROOT of a VULGAR FRACTION.

Note.—The same Rules, with regard to Fractions, which are given in Page 175, must be observed here, only extracting the Cube Root instead of the Square; that is, reduce the Fractions to their lowest Terms; if it be a mixed Number, to an improper Fraction; and if a Surd, to a Decimal.

EXAMPLES.

1. What is the Cube Root of $\frac{3}{125}\frac{24}{000}$?
2. What it the Root of $\frac{3}{11}\frac{52}{88}$?
3. What is the Cube Root of $5\frac{104}{125}$?
4. What is the Cube Root of $405\frac{28}{125}$?

SURDS.

5. What is the Cube Root of $5\frac{3}{5}$?
6. What is the Cube Root of $7\frac{5}{7}$?

53. The USE of the CUBE ROOT.

CASE I.

To find the Side of a Cube that shall be equal in Solidity to any given Solid, as a Globe, Cylinder, Prism, Cone, &c.

RULE.

Extract the Cube Root of the solid Content of the given Body, which Root will be the Side of the Cube required.

EXAMPLE.

EXAMPLE.

1. There is a Stone of a cubic Form, which contains 21925 ſolid Feet; what is the ſuperficial Content of one of its Sides?

CASE II.

Having the Dimenſions of any ſolid Body, to find the Dimenſions of another ſimilar Solid, that ſhall be any Number of Times greater or leſs than the Solid given.

RULE.

Multiply the Cube of each Side by the Difference between the Solid given and that required, if greater (or divide by the Difference if leſs) than the Solid given; then extract the Cube Root of each Product or Quotient, which will give the Dimenſions of the Solid required.

EXAMPLES.

2. Suppoſe the Length of a Ship's Keel to be 125 Feet, the Breadth of the Midſhip Beam 25 Feet, and the Depth of the Hold 15 Feet; I demand the Dimenſions of another Ship of the ſame Form, that ſhall carry three Times the Burthen?
3. Again, I demand the Dimenſions of another Ship of the ſame Form, that ſhall only be Half the Burthen of that whoſe Dimenſions are given as above?

CASE III.

Having the Dimenſions and Capacity of a Solid, to find the Dimenſions of a ſimilar Solid of a different Capacity.

RULE.

Like Solids are in triplicate Portion to their homologous Sides, therefore it will be as the Cube of a Dimenſion : is to its given Weight : : ſo is the Cube of any like Dimenſion : to the Weight ſought.

EXAMPLES.

4. If a Ship of 300 Tons Burthen be 75 Feet long in the Keel, I demand the Burthen of another Ship, whose Keel is 100 Feet long?
5. Suppose a Ball of 4 Inches Diameter weighs 18 lb. I demand the Diameter of another that weighs 114 lb.
6. If a Brass Saker, whose Diameter is 11,5 Inches, weighs 1000 lb. what will another Piece of Ordnance (of the same Metal and Shape) weigh, whose Diameter is 20,83 Inches?

CASE IV.

To find two mean Proportionals between two given Numbers.

RULE.

Divide the greater Extreme by the less, and the Cube Root of the Quotient, multiplied by the less Extreme, gives the lesser Mean; multiply the said Cube Root by the lesser Mean, and the Product will be the greater mean Proportional.

EXAMPLES.

7. What are the two mean Proportionals between 7 and 189?
8. Find two mean Proportionals between 4 and 256.

54. The SINGLE RULE of THREE in DECIMALS.

RULE.

Reduce the Fractional Parts into Decimals of the highest Name mentioned; then state the Question, and proceed as in Sect. 12, and 13.

EXAMPLES.

1. Suppose I give 6*s.* 3*d.* for 4¾ Yards of Cloth; what will 48½ yds. of the same come to at that Rate?
2. If 2½ lb. of Tea cost 1*l.* 5*s.* what will 14¼ lb. come to at the same Rate?
3. If 1 lb. of Sugar cost 11¼*d.* what will 4 hhds. each weighing

weighing Net 4 cwt. 2 qrs. 14 lb. coſt at the ſame Rate?

4. A Grocer buys 4 Cheſts of Tea, each weighing Net 2 cwt. 3 qrs. 14 lb. for 906*l*, 10*s*. at what Rate did he give per lb.?

5. How far will a Perſon be able to travel in 9 Days, 8 Hours, at the Rate of 12 Miles every 4 Hours, allowing 12 Hours to the Day.

6. An Oilman bought 4 Tuns 201½ Gallons of Florence Oil for 240*l*. 16*s*. 6*d*. but by Misfortune it chanced to leak out 24½ Gallons: I deſire to know at what he muſt ſell the Remainder per Gallon, to be no Loſer?

7. Goliah is ſaid to have been 6 Cubits and a Half, or a Span, high; this anſwers to 10 Feet 4 Inches and $\frac{74}{125}$: Pray what was the Length of the Cubit in Britiſh Meaſure?

QUESTIONS for Exerciſe at Leiſure Hours.

8. In a Series of proportional Numbers, the firſt is 5, the third 8; the Product of the ſecond and third is 78,4: What is the Difference of the Second and Fourth?

9. If the cubic Inch of Oil Olive be ,52835 Decimal Parts of an Ounce Avoirdupoiſe: What Quantity of Oil, weighing 7½ lb. per Gallon, will be contained in a Caſk allowed to hold 13⅓ Gallons of Water, each 282 ſolid Inches?

10. The cubic Inch of Marble is 1,5688 oz. Avoirdupoiſe; what Difference is there, in point of Weight, between a Figure containing a ſolid Foot and Half of Stone, and another of equal Dimenſions in Braſs 4,63 oz. whereof make a cubic Inch?

11. There are two Numbers, the leſſer 75, to which the greater is in Proportion as 8 to 5: What is their Sum, and the Product of their Sum and Difference, the Difference and Product of their Squares, and the Sum of the Square of their two Quotas, the greater divided by the leſs, and again the leſs by the greater?

12. There are two Numbers more, the greater 224, bearing Proportion to the other as 8 to 7: What is the Square of their Sum, Difference, and either Quota? What is the Reſult of the Square of the Sum of the

Difference, added to the Product of their Sum and Difference?

13. If during the Tide of Ebb, a Wherry ſhould ſet out from London weſtward, and at the ſame Inſtant another ſhould put off at Cheſſey for London, taking the Diſtance by Water at 34 Miles: the Stream forwards one and retards the other, ſay, $2\frac{1}{2}$ Miles an Hour: The Boats are equally laden, the Rowers equally good, and in the ordinary Way of working, in ſtill Water, would proceed at the Rate of 5 Miles an Hour: The Queſtion is, where in the River the two Boats would meet?

14. A Bullet of caſt Iron, 4 Inches Diameter, weighs experimentally 9 lb. What is the Difference of the Weight of one that is $13\frac{1}{2}$ Inches in Diameter, and another that is no more than $7\frac{1}{2}$ Inches?

15. A gay young fellow had 18200*l.* left him by an old Uncle, to whoſe Memory he expended three per Cent. of his whole Fortune, in a ſumptuous Funeral and Monument; 9 per Cent. of the Remainder he made a Preſent of to his Couſins, forgotten for his Sake by the old Man; with $\frac{3}{4}$ of what was left, he bought a fine Seat; with $\frac{5}{8}$ of the Reſidue a Stud of Horſes; he ſquandered away 550*l.* upon one Miſtreſs; and after he had lived at the Rate of 2000*l.* a Year for 19 Months together, he hath both ruined his Health and impaired his Fortune: Pray, at his Death, what was there left for his Siſter, who was his Heir at Law?

The Effects of Light and Heat.

The Effects or Degrees of Light, Heat, and Attraction, are reciprocally proportional to the Square of their Diſtances from the Center whence they are propagated.

16. Suppoſe that in a Room, where two Men, A. and B. are ſitting, there is a Fire, from which A. is three Feet, and B. is ſix Feet diſtant; it is required to find how much hotter it is at A.'s Seat than at B.'s?

17. Suppoſing the Earth to be 8100000 Miles diſtant from the Sun; I would know at what Diſtance from him another Body muſt be placed, ſo as to receive Light and Heat double to that of the Earth?

18. The Diſtance between the Earth and Sun is accounted

8100000

81000000 of Miles, the Diſtance between Jupiter and the Sun 424000000 of Miles, the Degree of Light and Heat received by Jupiter, compared with that of the Earth is required?

19. Mercury, the neareſt of the Planets to the Source of Heat, Light, and Life in our Syſtem, the Sun, is about 32 Millions of Miles from him; Saturn, the remoteſt of the Planets, is uſually diſtant about 777 Millions of Miles: What Compariſon or Proportion is there between the Solar Influences on theſe two Bodies?

20. Suppoſe, with Dr. Keil, the Diſtance of the Sun to be from us 115 of his Diameters; how much hotter is it then at the Surface of the Sun than under our Equator?

21. A Ball, deſcending by the Force of Gravity from the Top of a Tower, was obſerved to fall Half the Way in the laſt Second of Time: Required the Tower's Height, and the whole Time of Deſcent?

The leſs porous a Body is, the greater is its Denſity.

22. The Compactneſs or Denſity of the Moon is to that of the Earth, as 132½ is to 100: What Proportion then is there between the Quantity of Matter in the Earth and that in the Moon, ſince the Earth's Diameter is 7970 Miles, and that of the Moon 2170?

23. There is a vaſt Country in Ethiopia Superior, to whoſe Inhabitants the Moon doth always appear to be moſt enlightened when ſhe is leaſt enlightened, and to be leaſt when moſt, according to Gordon's Geographical Grammar: Admitting the mean Diſtance of the Earth and Moon's Centers 240000 Miles, in what Proportion is this Illumination?

Velocities acquired by heavy Bodies falling.

The Velocity acquired by heavy Bodies falling near the Surface of the Earth is 16½ Feet in the firſt Second, and as 16½ Feet are to the Square of one Second, or 1, ſo is the given Diſtance to the Square of the Seconds required; or, on the contrary, to determine what Space a heavy Body has paſſed in any Time given, is,

By multiplying 16½, the Deſcent of a heavy Body in one Second of Time, by as many of the odd Numbers, beginning

ning from Unity, as there are Seconds in the given Time, viz. by 1 for the firſt, 3 for the ſecond, 5 for the third, 7 for the fourth, &c. the Sum Total will give the Space it hath paſſed.

24. Suppoſe a Stone let go into an Abyſs ſhould be ſtopped at the End of the eleventh Second after its Delivery, what Space would it have gone through?
25. What is the Difference between the Depth of two Wells, into each of which ſhould a Stone be dropped at the ſame Inſtant, one will meet with the Bottom at 6 Seconds, the other at 10?
26. If a Stone be 19½ Seconds in deſcending from the Top of a Precipice to the Bottom, what is the Height of the ſame?
27. In what Time would a Muſquet-Ball, dropped from the Top of Saliſbury Steeple, ſaid to be 400 Feet High, be at the Bottom?
28. If a Hole could be bored through the Center of the Earth, in what Time after the Delivery of a heavy Body on its Surface, would it arrive at its Center?

50. The DOUBLE RULE of THREE in DECIMALS.

Reduce the Fractional Parts to Decimals, and then proceed as in Sect. 14.

EXAMPLES.

1. If 1*l.* 2*s.* worth of Wine will ſuffice a Club of 12 Perſons, when the Wine is ſold at the Rate of 25*l.* 4*s.* per hhd. how many Perſons will 1*l.* 12*s.* worth ſerve, when the Wine is ſold after the Rate of 18 Guineas per hhd.?
2. If 6 lb. of Pepper be Worth 13 lb. of Ginger, and 19 lb. of this be worth 4¼ lb. of Cloves, and 10 lb. be equivalent to 63 lb. of Sugar at 5*d.* per lb. what is the Value of 1 cwt. of Pepper?
3. What Money, at 3½ per Cent. will clear 38*l.* 2*s.* 6*d.* in a Year and a Quarter's Time?

QUESTIONS for Exerciſe at Leiſure Hours.

4. A. lent his good Friend B. fourſcore and eleven Guineas, from the 11th of December to the 10th of May following;

ing; B. on another Occaſion, let A. have 100 Marks, from September 3 to Chriſtmas following: Query, how long ought the Perſon be obliged to let his Friend uſe 40*l.* fully to retaliate the Favour?

5. A. B. and C. will trench a Field in 12 Days; B. C. and D. in 14; C. D. and A. will do it in 15; and D. A. and B. in 18; in what Time will it be done by all of them together, and by each of them ſingly?

6. A young Hare ſtarts 5 Rods before a Greyhound, and is not perceived by him till ſhe has been up 34 Seconds; ſhe ſcuds away at the Rate of 12 Miles an Hour, and the Dog, on View, makes after her at the Rate of 20: How long will the Courſe Hold, and what Ground will he run, beginning with the Out-ſetting of the Dog?

VIBRATIONS of PENDULUMS.

It hath been found by Experiment, that a Pendulum 39.2 Inches long, in our Latitude, vibrates 60 Times in one Minute; and that the Length of the Pendulums are to one another reciprocally, as the Square of the Number of their Vibrations made in the ſame Space of Time.

7. What Difference is there between the Length of a Pendulum that vibrates Half a Second, or 120 Times in a Minute, and another that ſwings double Seconds, or 30 Times in a Minute?

8. What Difference will there be in the Number of Vibrations made by a Pendulum of 6 Inches long, and another of 12 Inches long, in an Hour's Time?

9. What Difference is there in the Length of two Pendulums, the one ſwinging 30 Times, the other 100 Times in an Hour?

10. Give the Length of a Pendulum that will ſwing once in a Third, ditto in a Second, ditto in a Minute, ditto in an Hour, ditto in a Day?

11. Obſerved, that while a Stone was deſcending to meaſure the Depth of a Well, a String and Plummet, that from the Point of Suſpenſion, or the Place where it was held, to the Center of Oſcillation, or that Part of the Bob, which being divided by the circular Line, ſtruck from the Center above ſaid, would divide it into two Parts

of

of equal Weight, meaſured juſt 18 Inches, had made 8 Vibrations: Pray what was the Depth, allowing 1150 Feet per Second for the Return of Sound to the Ear?

55. FELLOWSHIP.

How to perform Fellowſhip, either Single or Double, without that tedious and laborious Taſk of making ſo many different Statings, as there are Perſons concerned.

RULES.

1. Divide the whole Gain or Loſs by the whole Stock.
2. The Quotient multiplied by each Perſon's particular Stock, and the ſeveral Products will be the reſpective Gain or Loſs of each.

Note.—This Rule is beſt adapted for Decimals.

EXAMPLES.

1. Three Perſons making a joint Stock, A. puts in 750*l.* B. 450*l.* and C. 300*l.* with which they trade a certain Time; and, when they Balance Accounts, find that they have gained 300*l.* What is the Share of each?
2. Three Merchants, A. B. and C. traded together; A. puts in 120*l.* for 8 Months, B. 250*l.* for 4 Months, and C. 100*l.* for 5 Months; they gained 184*l.* 10*s.* What is each Man's Share of the Gain?
3. Once as I walked upon the Banks of the Rye,
To ſee the purling Streams glide gently by,
And hear the pretty Birds to chirp and ſing,
Making the Groves with Melody to ring;
I, in the Meads, three beauteous Nymphs did ſpy,
That for their Pleaſure came as well as I;
And unto me their Steps they did direct,
Saluting me with moſt benign Reſpect,
Saying, Well met, we've Buſineſs to impart,
Which we cannot decide without your Art:
Our Grannum's dead, and left a Legacy,
Which is to be divided amongſt three;

In

In Pounds it is two hundred twenty-nine,
Also a good Mark, being Sterling Coin.
Then spake the eldest of the lovely three,
I'll tell you how it must divided be;
Likewise our Names I unto you will tell,
Mine is Moll, the others Anne and Nell.
As oft as I five and five-ninths do take,
Anne takes four and three-sevenths her Part to make;
As oft as Anne four and one-ninth does tell,
Three and two-thirds must be took up by Nell.

For more Examples, see Sect. 25. and 26.

Of Simple Interest, Annuities or Pensions, &c.

56. 1. SIMPLE INTEREST.

Here are five Letters to be observed, viz.

P=any Principal or Sum put to Interest.
I=the Interest.
T=the Time of the Principal's Continuance at Interest.
A=the Amount, or Principal and its Interest.
R=the Ratio, or Rate per Cent. per Annum.

Note.—The Ratio is the Simple Interest of 1*l.* for one Year, at any given Rate; and is thus found,

l. *l.* *l.* *l.*

Viz. 100 : 5 :: 1 : ,05 the Ratio at 5 per Cent. per Ann.
Or, 100 : 6 :: 1 : ,06 the Ratio at 6 per Cent. per Ann.
&c.

And in this Manner the Ratios in the following Table are found.

TABLE.

3 =,03	4½=,045
3½=,035	5 =,050
4 =,04	5½=,055

1. When the Principal, Time, and Rate per Cent. are given, to find the Interest.

RULE.

RULE.

Multiply the Principal, Rate, and Time, continually, into one another, the Product is the Intereſt ſought.

Or, if p= the Principal, t= the Time, r= the Rate, and I= the Intereſt, then the Theorem will be as follows.

THEOREM I. ptr=I.

EXAMPLES.

1. What is the Intereſt of 260*l.* 17*s.* 6*d.* for 5½ Years at 4½ per Cent. per Annum?
2. What is the Intereſt of 500*l.* from May the 12th, 1784, to November the 24th, 1789, at 3½ per Cent. per Ann.?

2. When the INTEREST required is for DAYS only.

RULE.

Multiply the Intereſt of 1*l.* for one Day, at the given Rate, by the Principal and Number of Days, it will give the Anſwer.

The Intereſt of 1*l.* for one Day, is thus found,

d. *l.* *d.* *l.*

Viz. As 365 : ,05 :: 1 : ,0001369863, &c.

Or 365 : ,035 :: 1 : ,0000958904 1, &c.

TABLE.

per Cent.	Decimals.
3 =	,0008219178
3½ =	,0009589041
4 =	,0010958904
4½ =	,0012328767
5 =	,0013698630

EXAMPLES.

3. What is the Intereſt of 370*l.* 10*s.* for 220 Days at 4½ per Cent. per Annum?
4. What is the Intereſt of 600*l.* from the 1ſt of July, 1784, to the 24th of February following, at 6 per Cent.?

When

When the Principal Term, and Rate per Cent. are given, to find the Amount.

RULE.

Find the Interest by Theorem 1, which, added to the Principal, will give the Amount.

Thus, THEOREM 2. $ptr+p=A$.

EXAMPLES.

5. What will 284*l.* 10*s.* amount to in 7 Years, at $3\frac{1}{2}$ per Cent. per Annum?
6. What will 672*l.* 5*s.* amount to in $5\frac{1}{2}$ Years, at $4\frac{1}{2}$ per Cent. per Annum?
7. What will 500*l.* amount to in 6 Years 120 Days, at $4\frac{1}{4}$ per Cent. per Annum?

When the Rate, Time, and Interest are given, to find the Principal.

RULE.

Divide the Interest by the Product of Rate and Time, the Quote is the Principal.

Thus, THEOREM 3. $\frac{I}{tr}=p$.

EXAMPLES.

8. I demand what Principal, being put to Interest for 3 Years, will gain 69*l.* 13*s.* 6*d.* at 5 per Cent. per Ann.?
9. I demand what Principal, being put to Interest for $5\frac{1}{2}$ Years, will gain 64*l.* 7*s.* at $4\frac{1}{2}$ per Cent. per Ann.?
10. I demand what Principal, being put to Interest for 4 Years, at 4 per Cent. will gain 67*l.* 15*s.* $9\frac{1}{2}$*d.*?

When the Amount, Rate, and Time are given, to find the Principal.

RULE.

Add 1 to the Product of the Rate and Time, and by that Sum divide the Amount, the Quote is the Principal.

Thus, THEOREM 4. $\frac{A}{tr+1}=p$.

EXAMPLES.

11. What Principal, being put to Intereſt, will amount to 354*l.* 4*s.* ½*d.* in 7 Years, at 3½ per Cent. per Annum?
12. What Principal, being put to Intereſt, will amount to 500*l.* 9*s.* 3½*d.* in 6 Years 5 Months, at 5 per Cent. per Annum?
13. What Principal, being put to Intereſt for 7 Years 220 Days, at 4½ per Cent. per Annum, will amount to 100*l.*

When the Principal, Intereſt, and Rate are given, to find the Time.

RULE.

Divide the Intereſt by the Product of the Principal and Rate, the Quote is the Time.

Thus, THEOREM 5. $\frac{I}{pr}=t.$

EXAMPLES.

14. In what Time will 464*l.* 10*s.* gain 69*l.* 13*s.* 6*d.* at 5 per Cent. per Annum?
15. In what Time will 260*l.* gain 64*l.* 7*s.* at 4½ per Cent. per Annum?
16. In what Time will 500*l.* gain 130*l.* 9*s.* 7*d.* at 6½ per Cent. per Annum?

When the Principal, Intereſt, and Rate are given, to find the Time.

RULE.

Divide the Amount leſs the Principal, by the Product of the Principal and Rate, the Quote is the Time.

Thus, THEOREM 6. $\frac{a-p}{pr}=t.$

EXAMPLES.

17. In what Time will 284*l.* 10*s.* amount to 354*l.* 4*s.* ½*d.* at 3½ per Cent. per Annum?

18. In

18. In what Time will 672*l.* 5*s.* amount to 847*l.* 17*s.* 6*d.* at $4\frac{3}{4}$ per Cent. per Annum?
19. In what Time will 378*l.* 18*s.* amount to 500*l.* 9*s.* $3\frac{1}{2}d.$ at $5\frac{1}{4}$ per Cent. per Annum?

When the Principal, Interest, and Time are given, to find the Rate per Cent.

RULE.

Divide the Interest by the Product of the Principal and Time, the Quote is the Rate.

THEOREM 7. Thus $\frac{I}{pt} = r$.

EXAMPLES.

20. At what Rate per Cent. will 464*l.* 10*s.* gain 69*l.* 13*s.* 6*d.* in 3 Years?
21. At what Rate per Cent. will 260*l.* gain 64*l.* 7*s.* in $5\frac{1}{2}$ Years?
22. At what Rate per Cent. will 560*l.* 12*s.* $8\frac{1}{2}d.$ gain 235*l.* 9*s.* 4*d.* in 7 Years?

When the Principal, Amount, and Time are given, to find the Rate.

RULE.

Take the Difference between the Amount and Principal, and divide it by the Product of the Principal and Time, the Quote is the Rate.

Thus, THEOREM 8. $\frac{a-p}{pt} = r$.

EXAMPLES.

23. At what Rate per Cent. will 284*l.* 10*s.* amount to 354*l.* 4*s.* $\frac{1}{2}d.$ in 7 Years?
24. At what Rate per Cent. will 378*l.* 18*s.* amount to 500*l.* 9*s.* $3\frac{1}{4}d.$ in 6 Years?
25. At what Rate per Cent. will 672*l.* 5*s.* amount to 847*l.* 17*s.* 6*d.* in $5\frac{1}{2}$ Years?

57. Of ANNUITIES, PENSIONS, &c. in ARREARS, At SIMPLE INTEREST.

An Annuity is a yearly Income ariſing from Money, &c. and is either paid for a Term of Years, or upon a Life.

Annuities or Penſions are ſaid to be in Arrears, when they are payable or due either Yearly, Half-Yearly, or Quarterly, and are unpaid for any Number of Payments.

Here U repreſents the Annuity, Penſion, or yearly Rent, A, T, R, as before.

When U, R, T, are given, to find A.

THEOREM 9. $\frac{ttu-tu}{2}\times r:+tu=A.$

When the Annuity, &c. is to be paid Half-Yearly, or Quarterly, then for Half-Yearly Payments, take Half the Ratio, Half the Annuity, &c. and twice the Number of Years; and for Quarterly Payments take a fourth Part of the Ratio, a fourth Part of the Annuity, and four Times the Number of Years, which work with as per Theorem.

EXAMPLES.

26. If 250*l.* yearly Rent, Penſion, &c. be forborn or unpaid 6 Years, what will it amount to in that Time, at 3 per Cent. for each Payment as it becomes due?
27. If a Salary of 250*l.* payable every Half-Year, remain unpaid for 6 Years, what would it amount to in that Time, at 3 per Cent. per Annum?
28. If a Salary of 250*l.* payable every Quarter, was left unpaid for 6 Years, what would it amount to in that Time, at 3 per Cent. per Annum?

It may be obſerved by comparing the Anſwers of the three laſt Examples, that the Half-Yearly Payment is more advantageous than the Yearly one, and alſo the Quarterly more than the Half-Yearly.

When A, R, and T, are given, to find U.

THEOREM 10. $\frac{2a}{ttr-tr+2t}=U.$

When

When the Payments are Half-Yearly, take $4a$; if Quarterly, $8a$; and proceed with the Ratio and Time as before.

EXAMPLES.

29. If a Salary payable Yearly amounts to 1612*l.* 10*s.* in 6 Years, at 3 per Cent. what is the Salary?
30. The Amount of a Salary payable Half-Yearly for 6 Years, at 3 per Cent. is 1623*l.* 15*s.* what is the Salary?
31. If the Amount of an Annuity, payable Quarterly, be 1629*l.* 7*s.* 6*d.* for 6 Years, at 3 per Cent. what is the Annuity?

When U, A, and T, are given, to find R.

THEOREM 11. $\frac{2a-2ut}{ut^2-ut}=R.$

When the Payments are Half-Yearly, take $4a-4ut$ for a Dividend; if Quarterly, take $8a-8ut$, and proceed with the Annuity and Time as is mentioned in Theorem 9.

EXAMPLES.

32. If a Salary of 250*l.* per Annum, amounts to 1612*l.* 10*s.* in 6 Years, what is the Rate per Cent.?
33. If a Salary of 250*l.* per Annum, payable Half-Yearly, amounts to 1623*l.* in 6 Years, what is the Rate per Cent.?
34. Suppose a Pension of 250*l.* per Annum, payable Quarterly, amounts to 1629*l.* 7*s.* 6*d.* in 6 Years, what is the Rate per Cent.?

When U, A, and R, are given, to find T.

THEOREM 12. First $\frac{2}{r}-1=X$. Then $\sqrt{\frac{2a}{ur}+\frac{xx}{4}};-\frac{x}{2}=T.$

When the Payments are Half-Yearly or Quarterly, proceed with the Ratio and Annuity as mentioned before, and T will be equal to those Half-Yearly or Quarterly Payments.

EXAMPLES.

35. In what Time will a Salary of *250l.* per Annum amount to 1612*l.* 10*s.* at 3 per Cent.?
36. If an Annuity of *250l.* per Annum payable Half-Yearly amounts to 1623*l.* 15*s.* at 3 per Cent. what Time was the Payments forborn?
37. If an Annuity of *250l.* per Annum, payable Quarterly, amounts to 1629*l.* 7*s.* 6*d.* at 3 per Cent. what was the Time of Forbearance?

58. PRESENT WORTH of ANNUITIES, &c.

Here P represents the present Worth; U, T, and R, as before.

When U, T, and R, are given, to find P.

THEOREM 13. $\frac{ttr-tr+2t}{2tr+2}:\times U=P.$

The same is to be observed here for Half-Yearly and Quarterly Payments, as before mentioned.

EXAMPLES.

38. What is the present Worth of *250l.* per Annum, to continue 6 Years?
39. What is a Pension of *250l.* per Annum worth in ready Money, payable Half-Yearly, at 3 per Cent. for 6 Years?
40. What is the present Worth of *250l.* payable Quarterly, for 6 Years, at 3 per Cent.?

When P, T, and R, are given, to find U.

THEOREM 14. $\frac{tr+1}{ttr-tr+2t}:\times 2p=U.$

When the Payments are Half-Yearly, multiply by $4p$; for Quarterly, by $8p$; and proceed with t and r as before directed.

EXAMPLES.

EXAMPLES.

41. What Annuity is that, which for 6 Years Continuance produces 1366*l.* 10*s.* 6*d.* present Worth, at 3 per Cent.?

42. There is an Annuity, payable Half-Yearly, for 6 Years to come; what is the yearly Income, when the present Worth, at 3 per Cent. is 1376*l.* 5*s.*?

43. There is an Annuity, payable Quarterly, for 6 Years to come; what is the yearly Income, when the present Worth is 1380*l.* 17*s.* 6*d.* at 3 per Cent.?

When U, P, and T, are given, to find R.

THEOREM. 15. $\frac{ut-p\times 2}{2pt+ut-utt}=R.$

When the Payments are Half-Yearly, or Quarterly, proceed with the Annuity and Time as before directed, and the Quotient will be the Answer accordingly; i. e. if for Half-Yearly, the Quotient will be Half the Ratio, and if for Quarterly, a fourth Part of the Ratio.

EXAMPLES.

44. At what Rate per Cent. will an Annuity of 250*l.* per Annum, to continue 6 Years, produce the present Worth of 1366*l.* 10*s.* 6*d.*?

45. If an Annuity of 250*l.* per Annum, payable Half-Yearly, having 6 Years to come, is sold for 1376*l.* 5*s.* what is the Rate per Cent.?

46. At what Rate per Cent. will an Annuity of 250*l.* per Annum, payable Quarterly, to continue 6 Years, produce 1380*l.* 17*s.* 6*d.* for the present Worth?

When U, P, and R, are given, to find T.

THEOREM 16. First $\sqrt[2]{\frac{2p}{r}+\frac{2}{u}}-1=x.$

Then $\sqrt{\frac{2p}{ur}+\frac{xx}{4}}-\frac{x}{2}=t.$

When

When the Payments are Half-Yearly or Quarterly, proceed with the Annuity and Ratio as before directed, and the Quotient will be the Number of Payments.

EXAMPLES.

47. If an Annuity of 250*l.* per Annum produces 1366*l.* 10*s.* 6*d.* for the preſent Worth at 3 per Cent. what is the Time of its Continuance?
48. An Annuity of 250*l.* per Annum, payable Half-Yearly, is ſold for 1376*l.* 5*s.* at 3 per Cent. I deſire to know the Number of Payments and Time to come?
49. Suppoſe a Leaſe of a Houſe of 250*l.* per Annum, payable Quarterly, is ſold for 1380*l.* 17*s.* 6*d.* at 3 per Cent. I demand the Number of Payments and Time to come?

59. ANNUITIES, &c. taken in REVERSION.

CASE I.

To find the preſent Worth of an Annuity taken in Reverſion.

RULES.

1. Find the Preſent Worth of the yearly Sum at the given Rate, and for the Time of its Continuance.
2. Change P into A, and find what Principal being put to Intereſt will Amount to A at the ſame Rate, and for the Time to come, before the Annuity, &c. commences.

THEOREM 17.

1. Thus $\frac{\overline{rr}-r+2}{2r+2}:\times U=P.$

2. Thus $\frac{a}{r+1}=P.$

EXAMPLES.

50. What is the preſent Worth of 250*l.* per Annum, to continue 6 Years, but not to commence until the End of 4 Years, allowing 3 per Cent. to the Purchaſer?
51. What is the preſent Worth of a Leaſe of 80*l.* per Annum,

num, to continue $7\frac{1}{2}$ Years, but not to commence until the End of 5 Years, allowing $4\frac{1}{2}$ per Cent. to the Purchaſer?

52. There is a Legacy of 40*l.* per Annum, for 10 Years, left to a Perſon of 14 Years of Age; the Time of Payment is not to commence till the ſaid Perſon's Age be 21; but he wanting a Sum of Money, is minded to ſell the ſame at 5 per Cent. I demand the preſent Worth?

To find the yearly Income of an Annuity, &c. in Reverſion.

RULES.

1. Find the Amount of the preſent Worth at the given Rate, and for the Time of its Continuance.
2. Change A into P, and find what Annuity being ſold will produce P at the ſame Rate, and for the Time of its Continuance.

Thus Theorem 18. $ptr+p=A$.

Thus $\frac{tr+1}{tr-tr+2t}:\times 2p=U$.

EXAMPLES.

53. A Perſon having an Annuity left him for 6 Years and 5 Months, but does not commence till the End of 4 Years, has diſpoſed of it for the preſent Payment of 1220*l.* 2*s.* $2\frac{1}{2}$*d.* allowing 3 per Cent. to the Purchaſer; what is the yearly Income?

54. There is a Leaſe of a Houſe taken for $7\frac{1}{2}$ Years, but not to commence until the End of 5 Years, the Leſſee would ſell the ſame for 419*l.* 15*s.* $1\frac{1}{2}$*d.* preſent Payment, allowing $4\frac{1}{2}$ per Cent. to the Purchaſer; what is the yearly Rent?

55. There is a Legacy of a certain Rate per Annum, for 10 Years, left to a Perſon of 14 Years of Age; but the Time of Payment is not to commence till the ſaid Perſon's Age be 21 Years; but he wanting a Sum of Money, ſold it for 241*l.* 19*s.* 6,074*d.* allowing 5 per Cent. to the Buyer, I demand the yearly Rate?

60. RE-

60. REBATE or DISCOUNT.

Here S repreſents the Sum to be diſcounted, P the preſent Worth, T and R as before.

When S, T, and R, are given, to find P.

THEOREM 19. $\frac{s}{tr+1}=P.$

EXAMPLES.

56. What is the preſent Worth of 150*l.* due 9 Months hence, at 5 per Cent.?
57. What is the preſent Worth of 1000*l.* due at 5 Months at 4½ per Cent.?
58. What is the Diſcount of 9342*l.* at 4 per Cent. for 10 Months?

When P, T, and R, are given, to find S.

THEOREM 20. $ptr+p=S.$

EXAMPLES.

59. Suppoſe I receive 144*l.* 11*s.* 6¾*d.* now, for a Sum of Money due 9 Months hence, allowing 5 per Cent. for preſent Payment: I demand the Sum that was due at firſt?
60. If the preſent Worth of a Sum of Money due 5 Months hence, allowing 4½ per Cent. to be 981*l.* 10*s.* 5*d.* what was the Sum firſt due?
61. A Perſon paid 9111*l.* 3*s.* 8½*d.* for a Debt due 10 Months hence, he being allowed 4 per Cent. for the Diſcount, how much was the Debt?

When S, P, and R, are given, to find T.

THEOREM 21. $\frac{s-p}{pr}=T.$

EXAMPLES.

62. The preſent Worth of 150*l.* due for a certain Time to come is 144*l.* 12*s.* 6¾*d.* at 5 per Cent. I demand in what Time the firſt Sum ſhould have been paid, if no Rebate had been made?

63. A

63. A Perſon receives 981*l.* 10*s.* 5*d.* for 100*l.* due at a certain Time to come, allowing 4½ per Cent. Diſcount; I deſire to know in what Time the Debt ſhould have been diſcharged without any Rebate?

64. I have received 9111*l.* 3*s.* 8½*d.* for a Legacy of 9342*l.* allowing the Executor 4 per Cent. I demand when the Legacy was payable without Rebate?

When S, P, and T, are given, to find R.

THEOREM 22. $\frac{s-p}{pt}=R.$

EXAMPLES.

65. At what Rate per Cent. will 150*l.* payable 9 Months hence, produce 144*l.* 11*s.* 6¼*d.* for the preſent Payment?

66. At what Rate per Cent. will 1000*l.* payable at 5 Months hence, produce 981*l.* 10*s.* 5*d.* for the preſent Payment?

67. At what Rate per Cent. will 9342*l.* payable 10 Months hence, produce 9111*l.* 3*s.* 8½*d.* for the preſent Payment?

EQUATION of PAYMENTS.

To find the equated Time for the Payment of any Sum of Money, due at ſeveral Times.

RULES.

1. Find the preſent Worth of each Payment for its reſpective Time. } Thus Theorem 23. $\frac{s}{tr+1}=P.$
2. Add all the preſent Worths together, and call that Sum P, then will $s-p=D$, the Rebate.
3. And $\frac{d}{pr}=E$, the true equated Time.

EXAMPLES.

68. B. owes C. 1400*l.* which was to have been paid as follows; 400*l.* down, 500*l.* at the End of 6 Months, 250*l.* at the End of 8 Months, and the Reſt at the End of 10 Months;

Months; but they agree to have but one Payment of the whole, Rebate at $3\frac{1}{2}$ per Cent. the true equated Time is demanded?

69. In what Time will the Intereſt of 49*l.* 3*s.* equal the Proceed of 12*l.* 6*s.* at Uſe 47 Days, at any Rate of Intereſt?

70. Put out 384*l.* to Intereſt, and in $8\frac{1}{4}$ Years there were 542*l.* 8*s.* found to be due; what Rate of Intereſt could then be implied?

62. COMPOUND INTEREST.

The Letters made uſe of here, are,

A, the Amount.
P, the Principal.
T, the Time.
R, the Amount of 1*l.* for 1 Year, at any given Rate, which is found by the following Proportion.

Thus,

As $\begin{cases} 100 : 105 :: 1 : 1{,}05 = R, \text{ at } 5 \text{ per Cent.} \\ 100 : 106 :: 1 : 1{,}06 = R, \text{ at } 6 \text{ per Cent. \&c.} \end{cases}$

The Conſtruction of the firſt Table following, ſhewing the Amount of 1*l.* for any Number of Years under 31, at 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, and 5 per Cent.

Thus the Amount of 1*l.* for 2 Years, at 5 per Cent. compound Integers, will be $1{,}05 \times 1{,}05 = 1{,}1025$.

Alſo, $1{,}05 \times 1{,}05 \times 105 = 1{,}157625$ = the Amount of 1*l.* for 3 Years, at 5 per Cent.

And the Conſtruction of the ſecond Table is by the Continual Multiplication of the Amount of 1*l.* for a Day; the Amount of 1*l.* for a Day being the Root of its Amount for a Year, extracted to the 365th Power.

The Amount of 1*l.* for a Day at 5 per Cent. is 1,0001336, its Amount for 2 Days will be $1{,}0001336 \times 1{,}0001336 = 1{,}0002672$, &c. and $1{,}0001836 \times 1{,}0001336 \times 1{,}0010336 = 1{,}0004011$, the Amount of 1*l.* at 5 per Cent. for 3 Days compound Intereſt.

TABLE

TABLE I.

The Amount of One Pound for Years.

Years.	3 per Cent.	3½ per Cent.	4 per Cent.	4½ per Cent.	5 per Cent.
1	1,0300000	1,0350000	1,0400000	1,0450000	1,0500000
2	1,0609000	1,0712250	1,0816000	1,0920250	1,1025000
3	1,0927270	1,1087178	1,1248640	1,1411661	1,1576250
4	1,1255088	1,1475230	1,1698586	1,1925186	1,2155063
5	1,1592740	1,1876863	1,2166529	1,2461816	1,2762816
6	1,1948523	1,2292553	1,2653190	1,3022601	1,3400956
7	1,2298733	1,2722792	1,3159318	1,3608618	1,4071004
8	1,2667700	1,3168090	1,3685691	1,4221006	1,4744554
9	1,3047731	1,3628973	1,4223118	1,4860251	1,5513282
10	1,3439163	1,4105987	1,4862443	1,5529694	1,6288946
11	1,3842338	1,4599697	1,5394541	1,6228530	1,7103393
12	1,4257608	1,5110686	1,6010322	1,6958814	1,7958563
13	1,4685337	1,5639560	1,6650735	1,7721961	1,8856491
14	1,5125897	1,6186045	1,7316764	1,8519449	1,97993.6
15	1,5579674	1,6753488	1,8009435	1,9352834	2,0789282
16	1,6047064	1,7339860	1,8729812	2,0223901	2,1828746
17	1,6528476	1,7946755	1,9479005	2,1133768	2,2920183
18	1,7024330	1,8574892	2,0258165	2,2308478	2,4066192
19	1,7535060	1,9225013	2,1068492	2,3078603	2,5269502
20	1,8061112	1,9897888	2,1911231	2,4117140	2,6532977
21	1,8602945	2,0594314	2,2787681	2,5202411	2,7859626
22	1,9161034	2,1315115	2,3699188	2,6336520	2,9252607
23	1,9735865	2,2061144	2,4647155	2,7521663	3,0715238
24	2,0327941	2,2833284	2,5633042	2.8760138	3,2251000
25	2,0937779	2,3632449	2,6658363	3,0054344	3,3863549
26	2,1565912	2,4459585	2,7724697	3,1406709	3,5546527
27	2,2212890	2,5315671	2,8833685	3,2820095	3.7334563
28	2,2879276	2,6201719	2,9987033	3,4296999	3,9201291
29	2,3565655	2,7118779	3,1186514	3,5840364	4,1161336
30	2,4272624	2,8067937	3.2433975	3,7453181	4.3219424

TABLE II.

The Amount of One Pound for Days.

Days.	3 per Cent.	3½ per Cent.	4 per Cent.	4½ per Cent.	5 per Cent.
1	1,0000809	1,0000942	1,0001074	1,0001206	1,0001336
2	1,0001619	1,0001885	1,0002149	1,0002412	1,0002673
3	1,0002429	1,0002827	1,0003224	1,0003618	1,0004011
4	1,0003240	1,0003770	1,0004299	1,0004824	1,0005348
5	1,0004050	1,0004713	1,0005374	1,0006031	1,0006685
6	1,0004860	1,0005656	1,0006449	1,0007238	1,0008023
7	1,0005670	1,0006600	1,0007524	1,0008445	1,0009361
8	1,0006480	1,0007542	1,0008600	1,0009652	1,0010699
9	1,0007291	1,0008486	1,0009675	1,0010859	1,0012037
10	1,0008101	1,0009429	1,0010751	1,0012066	1,0013376
20	1,0016209	1,0018867	1,0021512	1,0024148	1,0026770
30	1,0024324	1,0028315	1,0032288	1,0036243	1,0040182
40	1,0032445	1,0037771	1,0043074	1,0048354	1,0053611
50	1,0040573	1,0047236	1,0053871	1,0060479	1,0067059
60	1,0048708	1,0056710	1,0064680	1,0072618	1,0080525
70	1,0056849	1,0066193	1,0075501	1,0084773	1,0094009
80	1,0064996	1,0075685	1,0086333	1,0096942	1,0107511
90	1,0073151	1,0085186	1,0097177	1,0109125	1,0121031
100	1,0081311	1,0094696	1,0109803	1,0121324	1,0134563
110	1,0089479	1,0104214	1,0118900	1,0133537	1,0148125
120	1,0097653	1,0113742	1,0129779	1,0145765	1,0161699
130	1,0105834	1,0123279	1,0140670	1,0158007	1,0175291
140	1,0114021	1,0132825	1,0151572	1,0170265	1,0188932
150	1,0122215	1,0142379	1,0162487	1,0182537	1,0202531
160	1,0130415	1,0151943	1,0173412	1,0194824	1,0216178
170	1,0138623	1,0161516	1,0184350	1,0207126	1,0229843
180	1,0146837	1,0171098	1,0195299	1,0219442	1,0243527
190	1,0155057	1,0180689	1,0206261	1,0231774	1,0257228
200	1,0163284	1,0190288	1,0217233	1,0244120	1,0270949
210	1,0171518	1,0199897	1,0228218	1,0256481	1,0284687
220	1,0179759	1,0209315	1,0239215	1,0268858	1,0298444
230	1,0188006	1,0219142	1,0250223	1,0281249	1,0312219
240	1,0196260	1,0228778	1,0261243	1,0293655	1,0326013
250	1,0204520	1,0238424	1,0272275	1,0306076	1,0339825

When

When P, T, and R, are given, to find A.

THEOREM 1. $p \times rt = A$.

1. By the foregoing Tables, thus, Multiply the Principal by the tabular Number for the given Time and Rate, and the Product will be the Amount required.

If the Amount is required for any Number of Years or Days that are not in the Tables, then obſerve this Rule. Divide the given Number of Years or Days into ſuch Numbers as are in the Tables, then multiply the Amounts anſwering to each, into each other, continually, and the Product by the Principal, which will be the Amount required.

EXAMPLES.

1. What will 246*l.* 10*s.* amount to in 7 Years, at 5 per Cent. per Annum?
2. What will 500*l.* amount to in 30 Years or Days, at 4½ per Cent.?
3. What is the Amount of 523*l.* in 5 Years and 194 Days, at 5 per Cent.?

When A, R, and T, are given, to find P.

THEOREM 2. $\frac{A}{R} t = P$.

2. By the foregoing Tables, thus, divide the Amount by the tabular Number for the given Time and Rate, and the Quotient will be the Principal required.

EXAMPLES.

4. What Principal, or Sum of Money, muſt be put out to raiſe a Stock of 243*l.* 2*s.* ½*d.* in 4 Years, at 5 per Cent. per Annum?
5. What Principal, being put to Intereſt, will amount to 346*l.* 17*s.* in 7 Years, at 5 per Cent. per Annum?
6. What Principal, being put to Intereſt for 30 Years at 4½ per Cent. per Ann. will amount to 1872*l.* 13*s.* 2*d.*?
7. What Principal, being put to Intereſt for 5 Years and 194 Days, will amount to 685*l.* 7½*d.* at 5 per Cent. per Ann.?

When P, A, and R, are given, to find T.

THEOREM 3. $\frac{a}{p} = R^t$. { which being continually divided by r, till nothing remains, the Number of thoſe Diviſions will be equal to T, the Time.

3. By the foregoing Tables, thus, Divide the Amount by the Principal, and the Quotient will be the Amount of 1*l.* at the given Rate, which will be found under the Rate, even with the Time required.

EXAMPLES.

8. In what Time will 246*l.* 10*s.* amount to 346*l.* 17*s.* at 5 per Cent. per Annum?
9. In what Time will 530*l.* amount to 1872*l.* 13*s.* 2*d.* at 4½ per Cent. per Annum?
10. In what Time will 523*l.* amount to 685*l.* 7½*d.* at 5 per Cent. per Annum.

When A, P, and T, are given, to find R.

THEOREM 4. $\frac{a}{p} = R^t$. { which being extracted by the Rules of Extraction (the Time given to the Queſtion ſhewing the Power) will give the Rate.

4. By the foregoing Tables, thus, proceed as with the laſt, and even with the given Time is under the Rate required.

EXAMPLES.

11. At what Rate per Cent. will 146*l.* 10*s.* amount to 346*l.* 17*s.* in 7 Years?
12. At what Rate per Cent. will 500*l.* amount to 1872*l.* 13*s.* 2*d.* in 30 Years?
13. At what Rate will 523*l.* amount to 685*l.* 7½*d.* in 5 Years and 195 Days?

70. ANNUITIES, PENSIONS in ARREARS.

Here U repreſents the Annuity, Penſion, or yearly Rent, A, R, and T, as before.

The

The 3d Table ſhews the Amount of 1*l.* Annuity for any Number of Years under 31, at 3, 3½, 4, 4½, and 5 per Cent. and is thus conſtructed: Take the firſt Year's Amount, which is 1*l.* multiply it by 1,05+1=2,05=2d Year's Amount. Which alſo multiply by 1,05+1=3,1525=3d Year's Amount.

The 4th Table ſhews the preſent Worth of 1*l.* due at any Number of Years, to commence under 31, Rebate at 3; 3½, 4, 4½, and 5 per Cent. And is made thus 1÷1,05,=,952381 firſt Year's preſent Worth, and ,952381÷1,05=9070,295 =2d Year's, and ,90703÷1,05=,8638376, the third Year's preſent Worth, &c.

TABLE III.

The Amount of One Pound per Annum, or Annuity for Years.

Years.	3 per Cent.	3½ per Cent.	4 per Cent.	4½ per Cent.	5 per Cent.
1	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
2	2.0300000	2.0350000	2.0400000	2.0450000	2.0500000
3	3.0909000	3.1062250	3.1216000	3.1370260	3.1525000
4	4.1836270	4.2149429	4.2464640	4.2781911	4.3101250
5	5.3091358	5.3623659	5.4707097	5.4707097	5.5256312
6	6.4684099	6.5501522	6.6329755	6.7168917	6.0019128
7	7.6624622	7.7794075	7.8982943	7.0191518	8.1420084
8	8.8923360	9.0516860	9.2142263	9.3800136	9.5493643
9	10.1591061	10.3684958	10.5827953	10.8021142	11.0267871
10	11.4638793	11.7313931	12.0261071	12.2882094	12.5771925
11	12.8077957	13.1419919	13.4863514	13.8411788	14.2067871
12	14.1920296	14.6019616	15.0258055	15.4640319	15.9171265
13	15.6177904	16.1130303	16.6268397	17.1599133	17.7129828
14	17.0863242	17.6769864	18.2919112	18.9321094	19.5986320
15	18.5989139	19.2956809	20.0235876	20.7840543	21.5785636
16	20.1568813	20.9710297	21.8245311	22.7193367	23.6574918
17	21.7615877	22.7050158	23.6975124	24.7417069	25.8403664
18	23.4144354	24.4996912	25.6454129	26.8550837	28.1323847
19	25.1168684	26.3571805	27.6712294	29.0635625	30.5390039
20	26.8703745	28.2796818	29.7780786	31.3714228	33.0659541
21	28.6764857	30.2694707	31.9692017	33.7831368	35.7192518
22	30.5367803	32.3289022	34.2479698	36.5033779	38.5052144
23	32.4528837	34.4604137	36.6178886	38.9370299	41.4304651
24	34.4264702	36.6665282	39.0826041	41.6891963	44.5019989
25	36.4592643	38.9498567	41.6459083	44.5652101	47.7270988
26	38.5530422	41.3131017	44.3117446	47.5706446	51.1134538
27	40.7096335	43.7590602	47.0842144	50.7113236	54.6691265
28	42.9309225	46.2906273	49.9675830	53.9933332	58.4025828
29	45.2188502	48.9107993	52.9662863	57.4230332	62.3227119
30	47.5754157	51.6226773	56.0849277	61.0070607	66.4388475

TABLE

TABLE IV.

The present Worth of One Pound for Years.

Years.	3 per Ct.	3½ per Ct.	4 per Ct.	4½ per Ct.	5 per Ct.
1	,9708738	,9661836	,9615385	,9569378	,9523809
2	,9425959	,9331507	,9245562	,9157299	,9070295
3	,9151417	,9019427	,8889964	,8762966	,8638376
4	,8884870	,8714422	,8548042	,8385613	,8227025
5	,8626088	,8419732	,8219271	,8024511	,7835262
6	,8374843	,8135006	,7903145	,7678957	,7462154
7	,8130915	,7859910	,7599178	,7348285	,7106813
8	,7894092	,7594116	,7306902	,7031851	,6768394
9	,7664167	,7337310	,7025867	,6729044	,6446089
10	,7440939	,7089188	,6755642	,6439277	,6139133
11	,7224213	,6849457	,6495809	,6161988	,5846703
12	,7013799	,6617833	,6245971	,5896639	,5568374
13	,6809513	,6394041	,6005741	,5642716	,5303214
14	,6611178	,6177818	,5774751	,5399729	,5050679
15	,6418619	,5968906	,5552645	,5167204	,4810171
16	,6231669	,5767059	,5339082	,4944693	,4581115
17	,6050164	,5572038	,5133733	,4731764	,4362967
18	,5873846	,5383611	,4936281	,4528004	,4155207
19	,5702960	,5201557	,4746424	,4333018	,3957340
20	,5536758	,5025659	,4563870	,4146429	,3768895
21	,5375493	,4855709	,4388336	,3967874	,3489424
22	,5218925	,4691506	,4219554	,3797009	,3418479
23	,5066917	,4532856	,4057263	,3633501	,3255713
24	,4919337	,4379571	,3901215	,3477035	,3100639
25	,4776056	,4231470	,3751168	,3327306	,2953028
26	,4636947	,4088378	,3606892	,3184025	,2812407
27	,4501891	,3950123	,3468166	,3046914	,2678483
28	,4370768	,3816543	,3334775	,2915707	,2550936
29	,4243464	,3687482	,3206514	,2790150	,2429463
30	,4119868	,3562784	,3083187	,2670000	,2315775

When

When U, T, and R, are given to find A.

THEOREM 5. $\frac{Urt-u}{r-1}=A.$

By Table III. thus, multiply the Annuity by the tabular Number for the given Time and Rate, and the Product will be the Amount required.

EXAMPLES.

14. What will an Annuity of 70*l.* per Annum (payable yearly) amount to in 4 Years, allowing 4 per Ct. per Ann. ?
15. If a Salary of 100*l.* per Annum, to be paid yearly, be forborne 6 Years, or unpaid, at 5 per Cent. per Ann. what is the Amount?
16. A Minor of 14 had an Annuity left him of 70*l.* a Year, the Proceed of which, by Will, was to be put out, both Principal and Intereſt, yearly, as it fell due, at 3 per Cent. till he ſhould attain to 21 Years of Age; the utmoſt Improvement being made of this Part of his Fortune, what had he then to receive?
17. If an Annuity of 30*l.* per Annum, payable yearly, be omitted to be paid for 30 Years, at 3½ per Cent. what is the Amount?

When A, T, and R, are given, to find U.

THEOREM 6. $\frac{ar-a}{rt-1}=U.$

By Table III. thus, divide the Amount given by the tabular Number for the given Time and Rate, and the Quotient will be the Annuity required.

EXAMPLES.

18. What Penſion being forborne 6 Years, at 5 per Cent. will amount to 680*l.* 3*s.* 9½*d.* 6288?
19. What Annuity will amount to 5361*l.* 7*s.* 5½*d.* 45984 in 7 Years, at 3 per Cent.?
20. If the Payment of an Annuity be forborne 30 Years amount to 1548*l.* 13*s.* 7½*d.* at 3½ per Cent. What is the Annuity?

When

When U, A, and R, are given, to find T.

THEOREM 7. $\frac{\overline{ar+u-a}}{u}=Rt.$ { Which proceed with as in Theorem the 3*d*, which will give T the Time.

By Table III. thus, divide the Amount by the Annuity, and the Quotient will be the Amount of 1*l.* at the given Rate, which will be found under the said Rate even with the Time required.

EXAMPLES.

17. In what Time will a Salary of 100*l.* per Annum amount to 680*l.* 3*s.* 9¼*d.* at 5 per Cent.?
18. In what Time will an Annuity of 70*l.* amount to 536*l.* 7*s.* ¼*d.* 45984 at 3 per Cent.?
19. In what Time will 30*l.* per Annum amount to 1548*l.* 13*s.* 7¼*d.* 45984 at 3½ per Cent.?

When A, U, and T, are given, to find R*t*.

THEOREM 8. $\frac{ar}{u}-rt=\frac{a-u}{u}=R.$

This being a very high Equation, it requires the Assistance of Algebra to determine *R* by the Theorem.

By Table III. thus, proceed as in the last Rule, which will give the Annuity that 1*l.* will purchase for the given Time, which will stand even with the said Time, and under the Rate required.

EXAMPLES.

20. At what Rate per Cent. per Annum will a Salary of 100*l.* per Annum amount to 686*l.* 3*s.* 9¼*d.* 6288 in 6 Years?
21. At what Rate per Cent. per Annum will an Annuity of 70*l.* per Annum amount to 536*l.* 7*s.* 5¼*d.* 45984 in 7 Years?
22. At what Rate per Cent. per Annum will a Salary of 30*l.* per Annum amount to 1548*l.* 13*s.* 7¼*d.* 0264 in 30 Years?

63. PRE-

63. PRESENT WORTH of ANNUITIES, &c.

The 5th Table ſhews the preſent Worth of 1*l.* Annuity for any Number of Years under 31, at 3, 3½, 4, 4½, and 5 per Cent. and is made thus, Divide 1 by 1,05=,95238, the preſent Worth for the firſt Year, which ÷1,05=90703 added to the firſt Year's preſent Worth, =1,85941, the ſecond Year's preſent Worth again ,90703÷1,05 and the Quotient added to 1,85948=2,72324= third Year's preſent Worth, at 5 per Cent. &c.

The 6th Table ſhews the Annuity which 1*l.* will purchaſe for any Number of Years under 31, at 3, 3½, 4, 4½, and 5 per Cent. and is conſtructed by finding the preſent Worth of 1*l.* per Annum in the 5th Table, at the aſſigned Rate and Time, and dividing Unity or 1 thereby, the Quotient will be the Annuity, that 1*l.* will purchaſe at the ſame Rate for the ſame Time.

TABLE

TABLE V.

The present Worth of One Pound per Annum or Annuity for Years.

Years.	3 per Cent.	3½ per Cent.	4 per Cent.	4½ per Cent.	5 per Cent.
1	0,9708738	0,9661836	0,9615385	0,9569378	0,9523809
2	1,9124697	1,8996943	1,8860947	1,8726678	1,8594104
3	2,8286114	2,8016370	2,7750910	2,7489644	2,7232480
4	3,7170984	3,6730792	3,6298952	3,5875257	3,5459505
5	4,5797072	4,5150524	4,4518223	4,3899767	4,3294767
6	5,4171914	5,3285530	5,2421369	5,1578725	5,0756921
7	6,2302829	6,1145439	6,0020547	5,8927009	5,7863734
8	7,0196922	6,8739555	6,7327448	6,5958861	6,4632128
9	7,7861039	7,6076865	7,4353314	7,2687905	7,1078217
10	8,5302028	8,3169053	8,1108955	7,9127182	7,7217349
11	9,2526241	9,0015510	8,7604763	8,3289169	8,3064142
12	9,9540040	9,6633343	9,3850733	9,1185808	8,8632516
13	10,6349553	10,3027585	9,9856473	9,6828524	9,3935730
14	11,2960734	10,9205203	10,5631224	10,2228253	9,8986409
15	11,9379351	11,5174109	11,1183868	10,7395457	10,3796380
16	12,5611020	12,0941168	11,6522949	11,2340151	10,8377695
17	13,1661185	12,6513206	12,1656680	11,7071914	11,2740622
18	13,7535131	13,1896817	12,6592961	12,1599918	11,6895869
19	14,3237991	13,7098374	13,1339385	12,5939936	12,0853208
20	14,8774748	14,2124033	13,5903253	13,0099365	12,4622103
21	15,4150241	14,6979742	14,0291589	13,4047239	12,8211527
22	15,9369166	15,1671248	14,4511142	13,7844248	13,1630026
23	16,4436084	15,6204105	14,8568405	14,1477749	13,4885739
24	16,9355421	16,0583676	15,2469619	14,4954784	13,7986418
25	17,4131477	16,4815146	15,6220787	14,8220089	14,0939445
26	17,8768420	16,8903523	15,9827678	15,1466115	14,3751853
27	18,3270315	17,2853645	16,3295844	15,4513018	14,6430336
28	18,7641082	17,6670188	16,6630618	15,7428735	14,8981272
29	19,1884546	18,0357670	16,9837132	16,0218885	15,1410735
30	19,6004413	18,3920454	17,2920318	16,2888885	15,3724510

TABLE

TABLE VI.

The Annuity which One Pound will purchase for any Number of Years.

Years.	3 per Cent.	3½ per Cent.	4 per Cent.	4½ per Cent.	5 per Cent.
1	1,0300000	1,0350000	1,0400000	1,0450000	1,0500000
2	,5226108	,5264005	,5301961	,5339976	,5378049
3	,3535304	,3569342	,3603485	,3637734	,3672086
4	,2690271	,2722511	,2754901	,2785437	,2820118
5	,2183546	,2214814	,2246271	,2277916	,2309748
6	,1845975	,1876682	,1907619	,1938784	,1970175
7	,1605064	,1635445	,1666096	,1697015	,1728198
8	,1424564	,1454767	,1485279	,1516097	,1547218
9	,1284339	,1314460	,1344930	,1375745	,1406901
10	,1172305	,1202414	,1232909	,1263788	,1295046
11	,1080775	,1110920	,1141490	,1172482	,1203889
12	,1004621	,1034840	,1065522	,1096662	,1128254
13	,0940295	,0970616	,1001437	,1032754	,1064558
14	,0885263	,0915707	,0946690	,0978203	,1010240
15	,0837666	,0868251	,0899411	,0931138	,0963423
16	,0796109	,0826848	,0858200	,0890154	,0922699
17	,0759525	,0790431	,0821985	,0854176	,0886991
18	,0727087	,0758168	,0789933	,0822369	,0855462
19	,0698139	,0729403	,0791386	,0794073	,0827450
20	,0672157	,0703611	,0735818	,0768761	,0802426
21	,0648718	,0680366	,0712801	,0746006	,0779961
22	,0627474	,0659321	,0691988	,0725457	,0759705
23	,0608139	,0640188	,0673091	,0706825	,0741368
24	,0590474	,0622728	,0655868	,0689870	,0724709
25	,0574279	,0606740	,0640120	,0674390	,0709525
26	,0559383	,0592054	,0625674	,0660214	,0695643
27	,0545642	,0578524	,0612385	,0647195	,0682919
28	,0532932	,0566029	,0600130	,0635208	,0671225
29	,0521147	,0554454	,0588799	,0624146	,0660455
30	,0510193	,0543713	,0578301	,0613915	,0650614

When

When U, R, and T, are given, to find P.

THEOREM 9. $u-\frac{u}{rt}:\div r-1=P.$

By Table V. thus, Multiply the Tabular Number for the given Time and Rate, by the Annuity, &c. the Product will be the present Worth required.

[The Examples in Theorem 7 and 8, page 213, numbered 17, &c. to 22, should have been 21, &c. to 26.]

EXAMPLES.

27. What is the present Worth of an Annuity of 50*l.* per Annum, to continue 8 Years at 5 per Cent.?
28. What is the present Worth of an Annuity or yearly Rent of 60*l.* to continue 6 Years at 4 per Cent.?
29. What is the present Worth of a Pension of 1000*l.* per Annum, for 21 Years, at $4\frac{1}{2}$ per Cent.?

When P, T, and R, are given, to find U.

THEOREM 10. $\frac{\overline{prt\times r}-prt}{rt-1}=U.$

By Table V. thus, Divide the present Worth by the tabular Number for the given Time and Rate, and the Quotient will be the Annuity required.

Or by Table VI. thus, Multiply the tabular Number (for the given Rate and Time) by the present Worth, and the Product will be the Annuity.

EXAMPLES.

30. If the present Worth of 323*l.* 3*s.* $2\frac{1}{2}$*d.* 368 were required for a Pension of 8 Years to come, at 5 per Cent. what was the Pension?
31. What Annuity or yearly Rent may be purchased for 314*l.* 10*s.* $6\frac{3}{4}$*d.* 08544 at 4 per Cent. for 6 Years?
32. Suppose the present Worth of a Pension for 21 Years, at $4\frac{1}{2}$ per Cent. was 13404*l.* 14*s.* $5\frac{1}{2}$*d.* 944, what was the Pension?

When U, P, and R, are given, to find T.

THEOREM 11. $\frac{u}{p+u-pr}=R^t$. { Which proceed with as in Theorem 3, will give T.

By Table V. thus, Divide the preſent Worth by the Annuity, and the Quotient will be the Amount of 1*l.* at the given Rate, which will be found under the ſaid Rate, even with the Time required.

EXAMPLES.

33. How long may one have a Leaſe of 50*l.* yearly Rent for 323*l.* 3*s.* 2½*d.* 361, allowing 5 per Cent. to the Purchaſer?

34. If an Annuity of 60*l.* is purchaſed for 314*l.* 10*s.* 6¾*d.* 08544, at 4 per Cent. what Time ought it to continue?

35. I demand what Time a Leaſe of 1000*l.* may be purchaſed for, when the preſent Worth of 13404*l.* 14*s.* 5¾*d.* is made at 4½ per Cent.?

When U, P, and T, are given, to find R.

THEOREM 12. $\frac{u}{p}=\frac{u}{p}R^t+R^t-R^t+1$.

This being a very high Equation, requires the Aſſiſtance of Algebra to determine R.

By Table V. proceed as in the laſt Rule, and the Quotient will be the Amount of 1*l.* Annuity for the given Time, over which will be the Rate required.

EXAMPLES.

36. If an Annuity of 50*l.* to continue for 8 Years, be purchaſed for 323*l.* 3*s.* 2½*d.* 368, what Rate of Intereſt hath the Purchaſer for his Money?

37. Suppoſe I give 314*l.* 10*s.* 6¾*d.* 08544, for an Annuity of 60*l.* to continue 6 Years, at what Rate was Intereſt allowed?

38. If an Annuity of 1000*l.* to continue 21 Years be purchaſed for 13404*l.* 14*s.* 5½*d.* 944, what Rate of Intereſt is the Purchaſer allowed for his Money?

64. ANNUITIES,

64. ANNUITIES, LEASES, &c. taken in REVERSION.

To find the present Worth of Annuities, &c. in Reversion.

RULES.

1. Find the present Worth of the Annuity, &c. at the given Rate, and for the Time of its Continuance, by Theorem 9.
2. Change P into A, and find what Principal being put to Interest will amount to P at the same Rate and Time to come before the Annuity commences, by Theorem 2, which will give the present Worth of the Annuity.

Thus, $U - \frac{u}{r} : \div r - 1 = P.$

Thus $\frac{A}{R^t} = P.$

By Table V. thus, Find the present Value of *1l.* per Annum, at the given Rate, both for the Time being, and also for that and the Time in Reversion added together, then subtract the Time in being from the other, and multiply the Remainder by the Annuity, the Product will be the present Worth required.

EXAMPLES.

39. What is the present Worth of a Reversion of a Lease of 80*l.* per Annum, to continue 6 Years, but not to commence till the End of 2 Years, allowing 5 per Cent. to the Purchaser?
40. What ought a Person to give down in ready Money for the Reversion of 1000*l.* a Year, to continue 20 Years, on a Lease which cannot commence till 5 Years are at an End, allowing the Purchaser 5 per Cent.?

To find the yearly Income of an Annuity taken in Reversion.

RULES.

1. Find the Amount of the present Worth at the given Rate, and for the Time before the Annuity commences, by Theorem 1.

Thus, $pr^t = A.$

2. Change

2. Change A into P, and find what yearly Rent, &c. being ſold, will produce P at the ſame Rate, and for the Time of its Continuance, by Theorem 10.

Thus, $\frac{\overline{ptr\times r-prt}}{r^t-1}=U.$

By Table V. thus, proceed as in the laſt Rule, and divide the preſent Worth by the Remainder, the Quotient will be the Annuity required.

EXAMPLES.

41. What Annuity, to be entered upon two Years hence, and then continue 6 Years, may be purchaſed for 368*l.* 6*s.* 1*d.* ready Money, allowing 5 per Cent. to the Purchaſer?

42. Suppoſe the preſent Worth of a Leaſe of an Eſtate is 8132*l.* 14*s.* 8*d.* 064, taken in Reverſion for 20 Years, but not to commence till the End of 5 Years, allowing 5 per Cent. to the Purchaſer; what is the yearly Rent?

65. REBATE or DISCOUNT.

Here S. repreſents the Sum to be purchaſed.

When S, T, and R, are given, to find P.

THEOREM 13. $\frac{s}{rt}=P.$

By the 4th Table, thus, Multiply the tabular Number for the given Time and Rate, by the Sum to be purchaſed, the Product will be the preſent Worth?

EXAMPLES.

43. What is the preſent Worth of 150*l.* payable 4 Years hence, at 5 per Cent.?

44. What is the preſent Worth of 743*l.* 4*s.* 9*d.* payable 6 Years hence at 4 per Cent.?

When P, T, and R, are given, to find S.

THEOREM 14. $p\times rt=S.$

By

By Table IV. thus, Divide the present Worth by the tabular Number for the given Time and Rate, and the Quotient will be the Sum to be purchased.

EXAMPLES.

45. If 123*l.* 8*s.* 1¼*d.* be received for a Debt payable 4 Years hence, and an Allowance of 5 per Cent. to the Debtor for present Payment, what was the Debt?

46. If a Sum of Money due 6 Years hence produce 587*l.* 7*s.* 9¼*d.* 718, for present Payment, Rebate being made at 4 per Cent. I demand how much the Debt was?

When S, P, and R, are given, to find T.

THEOREM 15. $\frac{s}{p}=r^t$. { Which proceed with as in Theorem 3.

By Table IV. thus, Divide the Principal by the Sum to be purchased, and the Quotient will be the present Worth of 1*l.* at the given Rate, which will be found under the Rate, and even with the Time required.

EXAMPLES.

47. A Person received 123*l.* 8*s.* 1¼*d.* for a Debt of 150*l.* Rebate being made at 5 per Cent. I demand in what Time the Debt was payable?

48. The present Payment of 587*l.* 7*s.* 9¼*d.* 718, is made for a Debt of 743*l.* 4*s.* 9*d.* Rebate at 4 per Cent. I demand when the Debt was payable?

When S, P, and T, are given, to find R.

THEOREM 16. $\frac{S}{p}=R^t$. { Which proceed with as in Theorem 4.

By Table IV. thus, Proceed as in the last Rule, and the Quotient will be the present Worth of 1*l.* for the given Time, which will be found even with the Time, and under the Rate required.

EXAMPLES.

49. The present Worth of 150*l.* payable 4 Years hence, is 123*l.* 8*s.* 1¼*d.* at what Rate per Cent. is the Rebate made at?

50. The Sum of 743*l.* 4*s.* 9*d.* is payable in 6 Years Time, and the preſent Value of that Sum is 587*l.* 7*s.* 9¾*d.* 718, I demand at what Rate per Cent. the Rebate muſt be made?

66. PURCHASING Freehold or Real ESTATES

Is to find the preſent Worth of an Annuity, &c. to continue for ever.

When U, and R, are given, to find P.

THEOREM 17. $\frac{u}{r-1}=P.$

EXAMPLES.

51. Suppoſe a Freehold Eſtate of 500*l.* per Annum were to be ſold; what is the Worth, allowing 5 per Cent. to the Buyer?

52. What is an Eſtate of 25*l.* per Annum, to continue for ever, worth in preſent Money, allowing 4½ per Cent. to the Buyer?

When P, and U, are given, to find R.

THEOREM 18. $\frac{P+u}{p}=R.$

EXAMPLES.

53. Suppoſe one gave 10000*l.* for a Freehold Eſtate of 500*l.* per Annum, what Rate per Cent. has the Purchaſer for his Money?

54. If an Eſtate of 25*l.* per Annum is bought for 555*l.* 11*s.* 1½*d.* what is the Rate per Cent.?

When P, and R, are given, to find U.

THEOREM 19. $\overline{P+r-1}=U.$

EXAMPLES.

55. Suppoſe a Perſon would lay out 10000*l.* on a Freehold Eſtate, and ſo as to be allowed 5 per Cent. for his Money, what muſt be the annual Rent of ſuch an Eſtate?

56. If

56. If a Freehold Eſtate is bought for 555*l.* 11*s.* 1¼*d.* and the Allowance of 4½ per Cent. is made the Buyer; what is the yearly Rent?

67. Purchaſing FREEHOLD ESTATES in REVERSION.

To find the Worth of a Freehold Eſtate in Reverſion.

RULES.

1. Find the Worth of the yearly Rent, &c.
2. Change P into A, and find what Principal being put to Intereſt will Amount to A, at the ſame Rate, and for the Time to come before the Eſtate commences.

Theo. 20. Thus $\frac{u}{r-1}$

Thus $\frac{A}{R^t}=P.$

EXAMPLE.

57. What is an Eſtate of 500*l.* per Annum worth in ready Money, to continue for ever, but not to commence till the End of 4 Years, allowing 5 per Cent. to the Purchaſer?

To find the yearly Rent of an Eſtate taken in Reverſion.

RULES.

1. Find the Amount of the Worth of the Eſtate at the given Rate, and the Time before it commences.
2. Change A into P, and find what yearly Rent being ſold will produce P at the ſame Rate.

Theo. 21. $p\times r^t=A.$

$\frac{Pr\times r-pr}{r}=U.$

EXAMPLE.

58. A Freehold Eſtate is ſold for 8227*l.* 1*s.* 4*d.* which does not commence till the End of 4 years, the Buyer being allowed 5 per Cent. for his Money: I deſire to know the yearly Income?

QUESTIONS

QUESTIONS for EXERCISE.

59. Held of a College of 486*l.* 10*s.* a Year, on a reſerved Rent of 94*l.* Money being at 5 per Cent. Intereſt; what Fine ought ſeverally to be paid on a 7, a 14, and a 21 Year's Leaſe?

60. Suppoſe I would add 5 Years to a running Leaſe of 15 Years to come, the improved Rent being 186*l.* 7*s.* 6*d.* per Annum; what ought I to pay down in ready Money for this Favour, diſcounting 4 per Cent.?

61. A. has a Term of 7 Years in an Eſtate of 50*l.* per Annum; B. hath a Term of 14 Years in the ſame Eſtate; and C. hath a farther Term of 10 Years after B. in the ſame Eſtate: What is the preſent Value of the ſeveral Intereſts in the ſaid Eſtate?

62. For a Leaſe of certain Profits for 7 Years, A. offers to pay 150*l.* Gratuity, and 300*l.* per Annum; B. offers 400*l.* Gratuity, and 250*l.* per Annum; C. bids 650*l.* Gratuity, and 200*l.* per Annum; and D. offers 1800*l.* for the whole Purchaſe, without any yearly Rent: Query, which is the beſt Offer, and what Difference, computing at 4 per Cent.?

63. Value the Leaſe of a Houſe in tolerable Repair, the Rent 54*l.* 17*s.* a Year, the Ground Rent 7 Guineas, 3 Years of it only to come, the Rent payable every 6 Months, Diſcount per Compound Intereſt on this kind of purchaſe at 10*l.* per Cent.?

64. A Fine for a Leaſe of a Tenement is ſettled at 153*l.* under a reſerved Rent of 16*l.* a Year: Now the Tenant cannot conveniently pay more than 50*l.* but for the 6 Years to come of the Term, is willing rather to pay an adequate Rent, computing 10*l.* per Cent. per compound Intereſt; what ought that Rent to be?

65. Another Leaſe for 7 Years is agreed for at 250*l.* Fine, on the old Rent 44*l.* a Year; but conſidering the Contractor deſires to reduce the Rent to 20*l.* a Year, and pay a proper Fine, computing, as before, after the Rate of 10*l.* a Year; to what muſt the Fine be advanced?

66. A Son, previous to his Marriage, is minded to have 50*l.* a Year Freehold ſettled on his Family, and to have immediate Poſſeſſion of it, offers his Father in Lieu an Annuity,

Annuity, for his Life, valued at 12 Years Purchaſe, Diſcounting at 4 per Cent. thereon; whereas he is content the Eſtate ſhould be valued at a Diſcount of 3 per Cent. and conſequently will be worth $33\frac{1}{3}$ Years Purchaſe: Pray what had the Father for his Life?

67. A Gentleman took a College Leaſe of 237*l.* a Year, for 21 Years, and paid the full Fine; the Rent reſerved was 10*l.* a Year, but when 4 Years were elapſed, againſt the Marriage he renewed the Leaſe, and filled up the 21 Years. In 14 Years after that his Wife dying, he again renewed it in favour of his Daughter, then 7 Years of Age; and by the Time ſhe was 19, it was a third Time renewed in order to her Settlement: The Queſtion is, what Money the Society muſt have received from this Family from firſt to laſt, allowing 5*l.* a Year Diſcount on the Fines?

THE

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TUTOR's GUIDE.

PART IV.

68. MENSURATION.

GEOMETRICAL DEFINITIONS.

GEOMETRY contains the Nature and Properties of Lines, Angles, Surfaces, and Solids.

A Point is that which has no Parts or Magnitude.

A Line is Length conceived without Breadth.

An Angle is the mutual Inclination of two Lines which meet.

When a ſtrait Line, as C D, (Fig. 4.) ſtanding upon another, A B, makes the Angles, A D C, and C D E, on each Side equal to one another, each of theſe equal Angles is called a right Angle, and the dotted Line C D, is ſaid to be perpendicular to the Line A B.

An Angle is commonly expreſſed by three Letters, that placed at the angular Point being always wrote in the Middle, as A D C (Fig. 4.) denotes the Angle, *b*.

An obtuſe Angle is that which is greater than a right Angle, as C A B, (Fig. 3.)

An acute Angle is that which is leſs than a right Angle, as D C B, (Fig. 4.)

Parallel

Parrallel Lines are thoſe of which every Point of the one is at the ſame Diſtance from the other, as the Lines A B, and C D, (Fig. 2.)

A Superficies, or Surface, is an Extenſion of two Dimenſions, viz. Length and Breadth.

A Plane or Plane Superficies, is that with which a right Line may every Way coincide.

A Plane Superficies receives ſeveral Denominations, according to the Number and Poſitions of the Lines by which it is terminated, as follows:

Fig. 1. A Square is a right-angled equilateral Parallelogram, whoſe four Sides are equal, and its Angles all right ones.

A Quadrangle is a Figure made by four ſtrait Lines.

Fig. 2. A Parallelogram is a Quadrangle whoſe oppoſite Sides are parallel.

An Oblong, or Rectangle, is longer than broad; but its oppoſite Sides are equal, and all its Angles right ones.

A Rhombus, or Diamond Figure, is a Parallelogram whoſe Sides are all equal, but its Angles are not right Angles.

Fig. 3. A Rhomboides is an oblique angled Parallelogram, whoſe oppoſite Sides and Angles only are equal.

A Triangle is a Space included by three Lines, and of conſequence hath three Angles; for every rectilineal plane Figure hath as many Angles as Sides.

A right-angled Triangle, is that which has one right Angle, as Fig. in Page 177.

Fig. 4. An equilateral Triangle, is that whoſe three Sides are all equal to each other.

An iſoſceles Triangle, is that which has only two of its Sides equal to one another.

A Scalene Triangle, is that which has all its Sides unequal.

An obtuſe-angled Triangle, is that which has an obtuſe Angle.

An acute-angled Triangle, is that which has every Angle acute.

Fig. 5. A Trapezium is a Quadrangle, whoſe oppoſite Sides are not parallel.

All

All right-lined Figures, having more than four Sides, are called Polygons, and receive their Names from the Number of their Sides or Angles.

Fig. 6. Having five Sides or Angles is called a Pentagon.

A regular Polygon, is a Figure with equal Sides and equal Angles.

Fig. 7. A Circle is a plane Figure bounded by a curve Line called the Circumference, every Part whereof is equally diſtant from a Point within called the Center.

A Diameter, A B, of a Circle, is a right Line drawn through the Center, and terminated by the Circumference.

The Semi-Diameter, A C, is called the Radius.

A Semi-Circle, is a Figure contained under a Diameter, and that Part of the Circumference of a Circle cut off by that Diameter, as the Line A B divides the Circle into two Semi-Circles.

Fig. 8. A Segment is any Part of a Circle terminated by an Arc, A D B cut off by the Line A B, called the Chord.

Fig. 9. A Sector of a Circle, is a Portion contained between two right Lines or Semi-Diameters, and the intercepted of the Circumference.

Fig. 10. Repreſents the Front of an Arch built with Stones of equal Length, and is a Segment of a Sector.

The hollow Side, A B, of a Curve, is called Concave, and the raiſed Side, C D, Convex.

Fig. 11. An Ellipſis, or Oval, is a Figure bounded by a regular curve Line, returning into itſelf, but of its two Axis cutting each other in the Center, one of which is longer (called the tranſverſe Axis) than the other (called the conjugate Axis.)

A Solid is that which hath Length, Breadth, and Thickneſs.

Fig. 12. A Cube is a Solid bounded by ſix equal Squares.

Fig. 13. A Priſm is a Solid whoſe Sides are Parallelograms, and whoſe two Ends are parallel to each other.

Fig. 14. A Cylinder is a round Solid, like the Rolling-Stone of a Bowling-Green, whoſe two Ends are equal and parallel Circles.

Fig. 15. A Pyramid is a Solid, whoſe Baſe is a Polygon, or right-lined Figure, and whoſe Sides or Triangles meet in a Point, C, called the Vertex.

Fig.

Fig. 16. A Cone is a round Pyramid, or Pyramid having a circular Base, in form like a Sugar Loaf.

Fig. 17, 18. A Frustum of a Pyramid or Cone, is that Part which remains, when any Part next the Vertex is cut off by a Plane parallel to the Base.

Fig. 19. A Wedge is a Solid, having a rectangular Base, D B, and two of the opposite Sides ending in an Acies or Edge, E F.

Fig. 20. A Pavilion is a Solid contained under 5 Planes; the Base is a Rectangle or Oblong, and the four Sides terminate in a Ridge, E F, parallel to a Side of the Base, A B, or C D, but unequal to it.

Fig. 21. A Prismoid is a Solid contained under six Planes; the Bases, or Ends, are parallel Rectangles, and the four Sides are Quadrangles.

Fig. 22. A Sphere is a Solid bounded by a convex Surface, every Point of which is equally distant from a Point C, within, called the Center.

The Axis, or Diameter of a Sphere, is the right Line, A B.

Fig. 23. A Segment of a Sphere, is a Part cut off by a Plane, A B. If the Plane pass through the Center of the Sphere, it will cut it equally in two, and each Half is called a Hemisphere.

Fig. 24. A Spheroid is a Solid resembling an Egg, and is the Body conceived to be generated by the Revolution of an Ellipse about its Axis, and is denominated either prolate (oblong) or oblate, according as the Revolution is made about the transverse Axis or its conjugate.

The Axis about which the Revolution is made is the fixed Axis, the other is the revolving Axis.

Fig. 25. A parabolic Spindle is eight-fifteenths of its circumscribing Cylinder.

Fig. 26. Is the middle Frustum of a Spheroid.

68. SUPERFICIAL MEASURE.

PROBLEM I.

To multiply Feet, Inches, and Parts, by Feet, Inches, and Parts, which Method is termed Cross Multiplication, but more properly Duodecimal.

RULE.

Set the Feet in the Multiplier under the leaſt Denomination in the Multiplicand, and the Reſt in Order, beginning with the leaſt Denomination; divide each Product by 12, as you go on; place the firſt Remainder under the multiplying Figure, and the Reſt in Order, adding each Quotient to the next ariſing Product, as in Sect. 9. and having thus finiſhed Multiplication, the Sum of all will be the Product required.

In general, thus,

When Feet are concerned, the Product is of the ſame Denomination with the Term multiplying Feet.

When Feet are not concerned, the Name of the Product will be expreſſed by the Sum of the Indices of the two Factors.

EXAMPLES.

1. Multiply 17 Feet, 7 Inches, by 6 Feet.
2. Multiply 47 Feet, 8 Inches, by 8 Feet, 4 Inches.
3. Multiply 7 Feet, 10 Inches, by 8 Feet, 6 Inches.
4. Multiply 64 Feet, 7 Inches, by 4 Feet, 8 Inches.
5. Multiply 12 Feet, 8 Inches, 9 Parts, by 9 Feet, 6 Inches, 7 Parts.
6. Multiply 9 Feet, 11 Inches, 6 Parts, by 11 Feet, 8 Inches.
7. Multiply 64 Feet, 10 Parts, by 14 Feet, 9 Inches.
8. Multiply 124 Feet, 4 Inches, by 42 Feet, 9 Seconds.
9. Multiply 16 Feet, 7 Inches, 10 Parts, by 6 Feet, 5 Inches, 7 Seconds.
10. Multiply 474 Feet, 6 Inches, 8 Seconds, by 186 Feet, 7 Inches, 4 Seconds.
11. Multiply 24 Feet. 11′, 8″, 6‴, 7⁗, by 8 Feet, 6′, 7″.
12. Multiply 46 Feet, 6 In. 8′′, 4‴, by 6 Feet, 4 In. 8″, 6‴.

PROBLEM II.

To find the Area of a Parallelogram, whether it be a Square, a Rectangle, a Rhombus, or a Rhomboides.

RULE.

Multiply the Length by the Height or perpendicular Breadth, and the Product will be the Area.

If

If the Area of a Piece of Ground, in Yards, is divided by 4840 (the Number of ſquare Yards in one Acre) the Quotient will give the Number of Acres in the ſaid Piece. Or,

If the Area in Links, be divided by 100000 (the Number of ſquare Links in one Acre) the Quotient will give Acres.

That is, A B×A C=the Area.

Fig. 1.

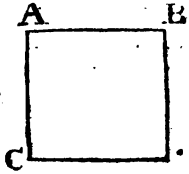


Fig. 2.

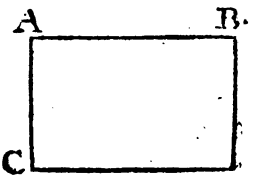
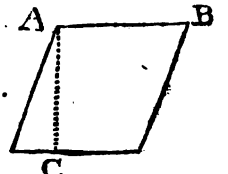


Fig. 3.



EXAMPLES.

1. What is the Area in Acres of a Parallelogram whoſe Length is 14,5 Chains, and its Breadth 9,75 Chains.
2. What is the Area of a Square, whoſe Side is 245 Yards or Chains, &c.
3. How many ſquare Yards of Paving are there in a Court-Yard, being in the Form of a Rhombus or Rhomboides, whoſe Length is 64 Feet, 6 Inches, and perpendicular Breadth is 47 Feet, 8 Inches?

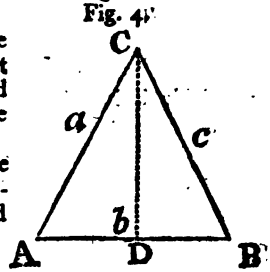
PROBLEM III.

To find the Area of a Triangle.

RULES.

1. Multiply one of its Sides by the Perpendicular let fall upon it from its oppoſite Angle, and Half the Product will be the Area.
2. Multiply the Baſe by Half the Perpendicular, or Perpendicular by Half the Baſe, and the Product gives the Area.

Fig. 4.



That is, $\frac{AB \times CD}{2}$ = the Area.

EXAMPLES.

4. How many Acres are in a triangular Field, whose Base is 28, and Perpendicular 20,5 Chains?
5. A triangular Field 738 Links long, and 583 in the Perpendicular, brings in 12*l.* a Year. What is it let at per Acre?

When the three Sides of a Triangle are given, to find the Area.

RULE.

3. From Half the Sum of the three Sides subtract each Side severally; multiply the Half Sum and the three Remainders continually together, and the Square Root of the last Product will be the Area of the Triangle, that is, $\frac{a+b+c}{2} = s$ = Half the Sum of the Sides.

Then let $s-a=r$, and $s-b=f$, also $s-c=g$; $\therefore \sqrt{srfg}$ = the Area.——Note. $a=AC$, $b=AB$, and $c=BC$. See the last Figure.

EXAMPLE.

6. Suppose I have a Fish-Pond of a triangular Form, whose three Sides measure 400, 348, and 312 Yards; what Quantity of Ground does it contain.

PROBLEM IV.

To find the Area of a Trapezium.

RULES.

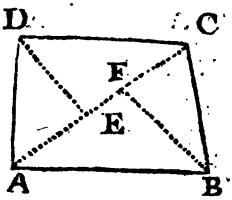
1. Divide it into Triangles according to the Manner which you judge most convenient; then the Sum of the Areas of those Triangles, calculated by the last Problem, will be the Area of the Trapezium. Or,

2. Multiply

2. Multiply the Sum of the Perpendiculars by Half the Diagonal, and the Product will give the Area; or multiply the Sum of the Perpendicular by the Diagonal, and Half the Product will be the Area.

That is, $\frac{DE+BF}{2} \times AC =$ the Area.

Fig. 5.



Or, 3. Subtract severally each Side from Half the Sum of the four Sides, and the square Root of the Product of the four Remainders will be the Area required.

EXAMPLES.

7. How many square Yards of Paving are there in a Trapezium, ABCD, whose Diagonal, BD, 45 Feet, and the Perpendiculars, AE, equal to 17,25, CF, equal to 14 Feet?

8. Suppose the four Sides of a Trapezium are 15,60; 13,20; 10, and 26 Chains: Quere, the Area?

PROBLEM V.

To find the Area of any regular Polygon.

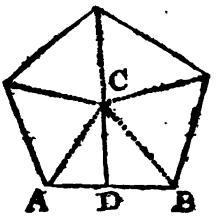
RULE I.

Let fall a Perpendicular from the Center of the Figure to one of its Sides, then multiply together the Perpendicular, the Side of the Figure, and the Number of its Sides, and Half the Product will be the Area.

Here the Number of Sides is 5=N.

Then it is, $\frac{AB \times CD \times n}{2}$ = the Area.

Fig. 6.



EXAMPLE.

9. A Piece of Garden Box lies in Form of a regular Pentagon, or Figure of Five equal Sides, (as above) each 48 Feet; and from the Center of the Figure, C, to the Middle of one of its Sides, D, it measures 41,57 Feet nearly, the Area of the Figure will be the Content of these five Triangles. Pray, what is that?

RULE II.

Multiply the Square of the Side of any regular Figure by the Multiplier standing opposite to its Name in the following Table, and the Product will be the Area.

No. of Sides.	Names.	Multipliers.
3	Trigon or equal △	0,433013
4	Tetragon or Square.	1,000000
5	Pentagon.	1,720477
6	Hexagon.	2,598076
7	Heptagon.	3,633912
8	Octagon.	4,828427
9	Nonagon.	6,181824
10	Decagon.	7,694209
11	Undecagon.	9,365641
12	Dodecagon.	11,196152

EXAMPLES.

10. What is the Area of an Hexagon, whose Side is 30?
11. What is the Area of an Octagon, whose Side is 24?

PRO-

PROBLEM VI.

To find the Diameter and Circumference of a Circle, the one from the other.

RULES.

1. Multiply the Diameter by 3,1416, and the Product will be the Circumference. And therefore,

2. Divide the Circumference by 3,1416, and the Quotient will be the Diameter.

3. See Sect. 51, Case 3.

EXAMPLES.

12. If the Diameter of a Circle be 7, what is the Circumference?

13. What is the Diameter of a Circle whose Circumference is 22?

14. What is the Circumference of the Earth, supposing it to be perfectly round, and its Diameter is 8000 Miles?

PROBLEM VII.

To find the Area of a Circle.

RULES.

1. Multiply Half the the Circumference by Half the Diameter, and the Product will be the Area. Or,

2. Multiply the Square of the Diameter by ,7854, and the Product will be the Area. Or,

3. Multiply the Square of the Circumference by ,079574, and the Product will be the Area. Or,

4. Multiply the Square of the Semi-Diameter by 3,1416, and the Product will be the Area. Or,

5. Multiply the Circumference by the Diameter, and a fourth Part of the Product will express the Area.

III. ,7854, and 3,1416, are Areas of Circles whose Diameters are 1 and 2, and ,079577 is the Area of a Circle whose Circumference is 1; likewise 452, and 1,273239, are Squares of the Diameters of Circles, whose Areas are 355, and 1, and 1283 is the Diameter of a Circle, whose Area is equal to a Square whose Side is 1.

For

For if the Diameter be Unity or 1, the Circumference will be 3,1415926, then per Rule I. $\frac{3,1415926}{2}\times\frac{1}{4}=$,785398 16, or rather ,7854, the Area. Alſo, if the Diameter be 2, the Circumference will be 6,2831853, then per Rule I. $\frac{6,2831853}{2}\times\frac{2}{2}=3,1415926$, or rather, 3,1416, the Area. Likewiſe $\frac{1}{3,1416}\times 1\div 4=$,079477 the Area, &c.

Let C= the Circumference, and D= the Diameter, A B.

Then per Rule I. $\frac{C}{2}\times\frac{D}{2}$ =the Area.

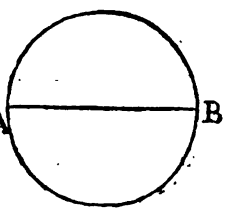


Fig. 7.

EXAMPLES.

15. How many Square Feet are in a Circle whoſe Circumference is 6,2832?
16. What is the Area of a Circle whoſe Diameter is 12?

PROBLEM VIII.

To find the Length of any Arc of a Circle, A D B.

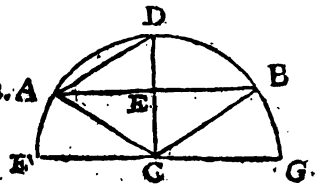


Fig. 8.

RULE.

RULE.

Multiply together the Radius, DC, the Number of Degrees in the given Arc, and the Number ,0174533, (b) the last Product will be the Length of the Arc; for, when the Radius is 1, Half the Circumference is 3,14159265, &c. and therefore, $\frac{3,14159265}{180 \text{ Degrees}} =$,0174533, or ,0174533, nearly which is the Length of an Arch of 1 Degree.

Hence CD×ADB×b=the Length of the Arc, ADB.

EXAMPLE.

17. What is the Length of the Arc, ADB, which is 29,5 Degrees, and Radius 9.

PROBLEM IX.

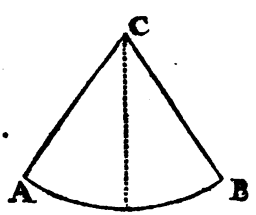
To find the Area of any Sector of a Circle.

RULE.

Multiply the Radius by Half the Arc of the Sector, found by the last Problem, and the Product will be the Area, as in the whole Circle.

That is, $AC \times \frac{AB}{2} =$ the Area.

Fig. 9.



EXAMPLE.

18. What is the Area of a Sector, whose Radius, CA, is 55, and the Length of the Arc, AB, 59.

PRO-

A TABLE of the Segments of Circles, whose Area is Unity or 1, the Diameter being divided by parallel Chord-Lines into 100 equal Parts.

V. S.	Segment.	V. S.	Segment.	V. S.	Segment.	V. S.	Segment.
1	,0017	26	,2066	51	,5127	76	,8155
2	,0048	27	,2178	52	,5255	77	,8262
3	,0087	28	,2292	53	,5382	78	,8369
4	,0134	29	,2407	54	,5509	79	,8474
5	,0187	30	,2523	55	,5635	80	,8576
6	,0245	31	,2640	56	,5762	81	,8677
7	,0308	32	,2759	57	,5888	82	,8776
8	,0375	33	,2878	58	,6014	83	,8873
9	,0446	34	,2998	59	,614	84	,8968
10	,052	35	,3119	60	,6265	85	,9059
11	,0598	36	,3241	61	,6389	86	,9149
12	,068	37	,3364	62	,6514	87	,9236
13	,0764	38	,3486	63	,6636	88	,932
14	,0851	39	,3611	64	,6759	89	,9402
15	,0941	40	,3735	65	,6681	90	,948
16	,1032	41	,3860	66	,7002	91	,9554
17	,1127	42	,3986	67	,7122	92	,9625
18	,1224	43	,4112	68	,7241	93	,9692
19	,1323	44	,4238	69	,736	94	,9755
20	,1424	45	,4365	70	,7477	95	,9813
21	,1526	46	,4491	71	,7593	96	,9866
22	,1631	47	,4618	72	,7708	97	,9913
23	,1738	48	,4745	73	,7822	98	,9952
24	,1845	49	,4873	74	,7934	99	,9983
25	,1955	50	,5	75	,8045	100	1,0000

EXAMPLES.

EXAMPLES.

19. Suppoſe the Diameter, FG, of a Circle to be 84 Inches, and the Height of the Segment, ED, 30 Inches, what will its Area be? (See Fig. 8.)
20. What is the Area of a Segment whoſe Arc is a Quadrant, or contains 90 Degrees, and Diameter 18 Feet?

PROBLEM XI.

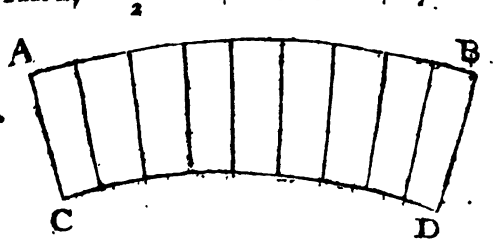
To find the Area of a Segment of a Sector, ABCD, or the Front of an Arch built with Stones of equal Length.

RULE.

Multiply Half the Sum of the bounding Arches, ABCD, by the Diſtance, AC, and the Product will give the Area.

That is, $\frac{AB+CD}{2} \times AC =$ the Area nearly.

Fig. 10.



EXAMPLES.

21. What is the Area of the Front of an Arch built with Stones 8½ Feet Long, whoſe upper and lower bounding Arcs are in Length 84 and 72½ reſpectively?
22. What is the Area contained between two concentric Semi-Circles, whoſe Diameters are 24 and 16?

PROBLEM XII.

To find the Area of an Ellipſis, or Oval.

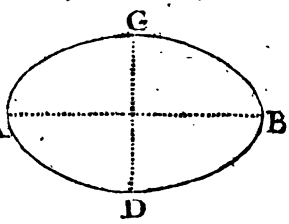
RULE.

Multiply continually together the two Axis, and the Number ,7854 (b) and the Product of theſe three Numbers will expreſs the Area.

That

That is, b×AB×CD= the Area.

Fig. 11.



EXAMPLE.

23. What is the Area of an Ellipſis whoſe greateſt Diameter is 24, and leaſt Diameter 18?

Of ARTIFICERS WORKS.

I. GLAZIERS and MASONS FLAT WORK is meaſured by the Foot Square.

EXAMPLES.

1. What is the Content of 12 Panes of Glaſs, each meaſuring 3 Feet 10 Inches long, and 2 Feet 8 Inches broad: What will the Glazing come to at 8½*d.* per Foot?
2. There is a Houſe with 3 Tier of Windows, 4 in a Tier, the Height of the firſt Tier is 6 Feet 6 Inches, the ſecond 5¼ Feet, and the Third 4¾ Feet, the Breadth of each Window is 3 Feet 9 Inches. What will the Glazing come to at 16*d.* per Foot?
3. What is the Price of a Marble Slab whoſe Length is of 6½ Feet, and Breadth 3¼ Feet, at 8*s.* per Foot?
4. A Looking Glaſs is 16 Inches by 9, and contains a Foot of Glaſs; what will the Content of the Plate be that has twice the Length, and three Times the Breadth?

II. PAINTING, PLAISTERING, PAVING, &c. is meaſured by the Yard Square, which is 9 Square Feet.

RULE.

Divide the Square Feet by 9, and the Quotient will be the Number of Square Yards.

EXAMPLES.

5. What will the Paving of a Street come to at 6*d.* per Yard, the Length of the Street being 176½ Feet, and the Breadth 56¼ Feet?
6. What is the Content of a Piece of Wainscotting in square Yards, that is 9¼ Feet in Height, and 8¼ Feet broad, and what will it come to at 6*s.* per Yard?
7. There is a Room 84 Feet round, and 9 Feet 6 Inches high, in which are three Windows, each 6 Feet High and 3 Feet 5 Inches wide, and the Fire Place 4 Feet by 4 Feet; I demand how many Yards of Paper, Half-Yard wide, will hang it?
8. If my Court-Yard be 47 Feet 7 Inches square, and I have laid a Footway of Purbeck Stone 4 Feet wide along one Side of it; what will paving the Rest with Flints come to, at 6*d.* per Yard square?
9. A rectangular four-sided Room measures 129½ Feet about, and is to be wainscotted at 3*s.* 6*d.* per Yard square; after the due Allowances for Girt of Cornice and Member, it is 16¼ Feet high; the Door is seven Feet by 3¼ Feet; the Window Shutters, two Pair, are 7¼ Feet by 4½ Feet; the Check Boards round them come 1¼ Foot below the Shutters, and are 14 Inches in Breadth; the lining Boards round the Door-Way are 16 Inches broad; the Door and Window Shutters being wrought on both Sides, are reckoned Work and Half, and paid for accordingly; the Chimney 3¾ Feet by 3 Feet, not being inclosed, is to be deducted from the superficial Content of the Room; and the Estimate of the Charge is required?
10. What will Plaistering of a Ceiling, at 10½*d.* per Yard, come to, supposing the Length 34½ Feet, and the Breadth 20 Feet?
11. There is a Quantity of Partitioning that measures 34 Feet 8 Inches about, and 14½ Feet High; but is rendered between Quarters: The Lathing and Plaistering will be 8*d.* per Yard, and the Whiting 2*d.* per Yard; what will the Whole come to?

Note.—In measuring Plaistering, rendering between Quarters, there is commonly a Fifth Part of the whole Area deducted; but when rendering between Quarters is whited or coloured, there is commonly a fourth or fifth Part added

added to the whole Area, for Sides of the Quarters and Braces, &c.

III. FLOORING, PARTITIONING, ROOFING, TYLING, &c. is meaſured by the Square of 100 Feet.

In theſe Meaſurements, the Dimenſions are taken by a Rod of 10 Feet long; and therefore the Reſult is in Squares of 100 Square Feet each.

Hence, dividing the Area in ſquare Feet by 100, the Quotient will be the Number of Squares required.

EXAMPLES.

12. In 120½ Feet in Length, and 12¼ Feet in Height of Partitioning, how many Squares?
13. What Difference is there between a Floor 28 Feet long, by 20 broad, and two others that meaſure 14 Feet apiece by 10; and what do all three come to, at *2l. 5s.* per Square?
14. Suppoſe a Houſe three Stories, beſides the Ground Floor, was to be floored, at *8l. 10s.* per Square; the Houſe meaſures 30½ Feet by 20½ Feet; there are eight Fire Places, whoſe Meaſure are four of 6 Feet by 5½, and four of 4½ Feet, by 4, and the Well Hole for the Stairs is 10 Feet by 8½; what will the Whole come to?
15. How many Oaken Planks will floor a Room 60½ Feet long, and 33½ wide, ſuppoſing the Plank 15 Feet long, and 1¼ wide?
16. Suppoſe a Houſe meaſures, within the Walls, 64 Feet in Length, and 36 Feet in Breadth, and to be of a true Pitch, what will it come to roofing, at *12s. 6d.* the Square?
17. Suppoſe I employ a Perſon to thatch a Barn, which is 70 Feet long, and 30 deep; I demand how many Squares are contained in the Whole; alſo what it will come to at *10s. 8d.* per Square?
18. What will the new Ripping an Out-Houſe coſt, that meaſures 32½ Feet long, by 22½ broad, upon the flat, at *15s.* the Square; the Eaves Boards projecting 10 Inches on each Side?

Note.—In Tyling and Roofing, it is cuſtomary to reckon the Flat, and Half of any Building within the Walls, to be

the Depth or Width of the Roof of that Building; when the ſaid Roof is of a true Pitch, that is, when the Rafters are $\frac{1}{4}$ of the Breadth of the Building: But when the Roof is more or leſs than the true Pitch, they meaſure from one Side to the other.

IV. Bricklayers Work is meaſured by the Rod, of 272$\frac{1}{4}$ Square Feet.

This Work is always valued at the Rate of a Brick and a Half thick, and if the Thickneſs of the Wall is more or leſs, it muſt be reduced to that Thickneſs, by the following

RULES.

1. Multiply the Area of the Wall in Feet, by the Number of half Bricks in the Thickneſs the Wall is of; divide the Product by 816$\frac{3}{4}$, and the Quotient will be the Content in Rods:—Or,
2. Multiply the Area of the Wall by the Number of half Bricks the Thickneſs of the Wall is of; the Product divided by 3, gives the Area in Feet, which divide by 272$\frac{1}{4}$, the Quotient will be the Rods required.

Note.—The Fraction $\frac{3}{4}$ in Rule 1, or $\frac{1}{4}$ in Rule 2, is rejected in Favour of the Workmen.

EXAMPLES.

19. There is a Brick Wall 470 Feet round, and 9$\frac{1}{2}$ Feet high, and three Bricks thick, how many Rods doth it contain?
20. A Gentleman built a Wall round his Garden, which is 840 Feet, and 9 Feet high, and 2$\frac{1}{2}$ Bricks thick; how many Rods doth it contain, and what will it come to at 4*l.* 19*s.* 6*d.* per Rod?
21. The End Wall of a Houſe is 24$\frac{1}{2}$ Feet in Breadth, and 40 Feet to the Roof; $\frac{1}{3}$ of which is two Bricks thick, $\frac{1}{3}$ more 1$\frac{1}{2}$ Brick thick, and the Reſt 1 Brick thick: Now the Gable riſes 38 Courſe of Bricks (4 of which uſually make a Foot in Depth) and this is but 4 Inches, or half a Brick thick: What will this Piece of Work come to, at 5*l.* 10*s.* Statute Rod?

QUESTIONS

QUESTIONS for Exerciſe in SUPERFICIAL MEASURE.

1. An Elm Plank is 14¼ Feet long, and I would have juſt a Yard Square ſlit off; at what Diſtance from the Edge muſt the Line be ſtruck?
2. Having a rectangular Marble Slab, 58 Inches by 27, I would have a Foot ſquare cut off, parallel to the ſhorter Edge; I would then have the like Quantity divided from the Remainder, parallel to the longer Side, and this alternately repeated till there ſhould not be the Quantity of a Foot left; what will the Dimenſion of the Remainder be?
3. Being about to plant 10584 Trees equally diſtant in Rows, the Length of the Grove muſt be 6 Times the Breadth: How many of the ſhorter Rows will there be?
4. A common Joiſt is 7 Inches deep, and 2½ thick: But I want a Scantling juſt as big again, that ſhall be three Inches thick: What will the other Dimenſions be?
5. I have a ſquare Girder 19 Inches by 11; but one Quarter of the Timber in it (provided it be 9 Inches deep) will ſerve: How broad will it be?
6. I have a wooden Trough, that, at 6*d.* per Yard, coſt me 3*s.* 2*d.* painting within; the Length of it was 102 Inches, the Depth 21 Inches; what was its Breadth?
7. My Plumber has put 28 lb. per Foot ſquare into a Ciſtern 74 Inches, and twice the Thickneſs of the Lead long, 26 Inches broad, and 40 deep; he has put three Stays within, acroſs it 16 Inches deep, of the ſame Strength, and reckons 22*s.* per cwt. for Work and Materials: I, being a Maſon, have paved him a Workſhop, 22 Feet 10 Inches broad, with Purbeck Stone, at 7*d.* per Foot, and upon the Balance I find there is 3*s.* 6*d.* due to him; what was the Length of his Workſhop?
8. The rectangular Powdering Trough of a Man of War meaſures 27 ſquare Feet, 112 Inches; the Depth is 20 Inches, the Breadth 16: The Length is ſought?
9. In 110 Acres of Statute Meaſure, in which the Pole is 16½ Feet long, how many Cheſhire Acres, where the Cuſtomary Pole is 6 Yards long; and how many Yorkſhire, where the Pole in Uſe is ſeven Yards in Length?

10. I would ſet 3584 Plants in Rows, each 4 Feet aſunder, and the Plants 7 Feet a-part, in a rectangular Plot of Ground: What Land will this take up?

11. The Paving of a triangular Court, at 18*d.* per Foot, came to 100*l.* the longeſt of the three Sides was 88 Feet; what then was the Sum of the other two equal Sides?

12. An ancient Bath was found of a triangular Form, the Sum of whoſe three equal Sides was 125 Feet; the Area of the Bottom is required?—See Prob. III. Rule III.

13. I would plant 10 Acres of Hop Ground, which muſt be done either in the Square Order, as the Number 4 ſtands on the Dice, or in the quincunx Order, as the Number 5; the three neareſt Binds, in both Caſes, muſt be ſet lineally juſt 6 Feet aſunder: How many Plants more will be required for the laſt Order than for the firſt, admitting the Form of the Plot to lay the moſt advantageous for the Plantation in either Caſe?

14. A Summer Houſe is a Cube of 10 Feet, in the clear Cornice of which projects juſt 15 Inches on a Side, and being of Timber and Stucco, the Sides are 6 Inches thick, ſo that the whole Front of the Roof, from Out to Out, is $13\frac{1}{2}$ Feet; this is hipped from each of the Corners to the Center, and being truly Pediment Pitch, it riſes $\frac{2}{11}$ of the Front, or 3 Feet. I would, by Help of theſe Dimenſions, meaſure the Slating without venturing to climb for more, and compute the Coſt $3\frac{1}{2}$*d.* per ſquare Foot?

15. A triangular Bath, 6 Feet deep, is exactly incloſed by 3 ſquare Pavilions, and rectangular, the Sum of whoſe Planes together make juſt 50 Poles: The Area of A, the leſs, is to that of B, the middle One, as $4\frac{1}{2}$ to 8; and the Sum of the Areas of A and C, the biggeſt, is to that of B, as $8\frac{1}{2}$ to 4: How many Wine Hogſheads of Water will this Bath receive?

16. I have an Orchard in the Form of a Quadrangle or Trapeze, containing $3\frac{3}{4}$ Acres, which being divided by a Diagonal, or Line from Corner to Corner, the Perpendicular of one of the Triangles is 430 Links, and the other 360: The Length of the ſaid Diagonal, or common Baſe of thoſe Triangles, is required?

17. Give

17. Give the Area of a circular Bowling Green that is 16 Poles acroſs the Middle, the Circumference being 3,1416 Times the Diameter of a Circle?
18. The ſurveying Wheel is ſo contrived as to turn juſt twice in the Length of a Pole, or $16\frac{3}{4}$ Feet; what then is the Diameter?
19. I would turf a round Plot, meaſuring 130 Feet about, and would know the Charges, at 4*d.* per Yard ſquare?
20. I want the Length of a Line, by which my Gardener may ſtrike a round Aurangerie, that ſhall contain juſt Half an Acre of Land?
21. Agreed for an Oaken Curb to a round Well, at 8*d.* per ſquare Foot; it is exactly 42 Inches in Diameter, within the Brick Work, and the Breadth of the Curb is to be $14\frac{1}{2}$ Inches, what will it come to?
22. It is obſerved, that the extreme End of the Minute-Hand of a public Dial moves juſt 5 Inches in the Space of $3\frac{1}{4}$ Minutes: The Queſtion is, what is the Length of that Index?
23. A. B. and C. join for a Grinding Stone, 36 Inches in Diameter, Value 20*s.* toward which A. paid 7*s.* B. 8*s.* and C. 5*s.* the waſte Hole through which the Spindle paſſed was 5 Inches ſquare; to what Diameter ought the Stone to be worn, when B. and C. begin ſeverally to work with it?
24. I demand what Difference there is in the Area of the Section of a round Tree, 20 Inches over, and its inſcribed and circumſcribed Squares?
25. Having paved a Semi-Circle Alcove with black and white Marble, at 2*s.* 4*d.* per Foot; the Maſon's Bill was juſt 10*l.*; what then was the Arch in Front?
26. What Proportion is there between the Arpent of France, which contains 100 ſquare Poles of 18 Feet each, and the Engliſh Acre, containing 160 Square Poles of $16\frac{1}{2}$ Feet each, conſidering that the Length of the French Foot is to the Engliſh, as 16 to 15?
27. In turning a one Horſe-Chaiſe within a Ring of a certain Diameter, it was obſerved, that the outer Wheel made two Turns, while the Inner made but one: The Wheels were equally high, and ſuppoſing them fixed at the ſtatutable Diſtance, or 5 Feet aſunder on the Axle-tree; pray what was the Circumference of the Track deſcribed by the outer Wheel?

28. Received

28. Required the Area of a Sector, (ſuppoſing one of the Diviſions of a Wilderneſs) which being ſtruck from a Center with a Line 30 Yards long, makes the Sweep, or circular Part, 63 Feet, is required?

29. If the Chord or Line drawn through the two Ends of the above Curve, be 15 Inches ſhorter than the Arch Line, I demand the Segment?

30. Suppoſe the Ellipſe in Groſvenor Square meaſures 840 Links the longeſt Way, and 612 acroſs, within the Rails; and if the Curb Stones are 14 Inches thick; what Ground do they encloſe, and what do they ſtand upon?

The Dimenſions of all ſimilar Figures are in Proportion to their Areas, as the Squares of their reſpective Sides, et contra.

31. If a round Pillar, 7 Inches over, has 4 Feet of Stone in it, of what Diameter is the Column, of equal Length, that meaſures ten Times as much?

32. A Pipe of 6 Inches bore will be 3 Hours in running off a certain Quantity of Water: In what Time will 4 Pipes, each 3 Inches bore, be in diſcharging double the Quantity?

33. Suppoſe a Yard of Rope 9 Inches round, weighs 22 lb. what will a Fathom of that weigh which meaſures a Foot about?

34. If 20 Feet of Iron Railing ſhall weigh Half a Ton when the Bars are an Inch and Quarter ſquare; what will 50 Feet of ditto come to, at $3\frac{1}{2}d.$ per lb. the Bars being but $\frac{7}{8}$ of an Inch ſquare?

35. A Sack that holds three Buſhels of Corn is $22\frac{1}{2}$ Inches broad when empty; what would the Sack contain, that being of the ſame Length, had twice its Circumference, or twice its Breadth?

36. My Plumber has ſet me up a Ciſtern, and his Shop-Book being burnt, he has no Means of bringing in the Charge, and I do not chuſe to take it down to have it weighed; but by Meaſure he finds it contains 64 ſquare Feet $\frac{3}{16}$, and that it was $\frac{3}{4}$ of an Inch preciſely in thickneſs. Lead was then wrought at 21*l.* per Fodder.—Let the Accomptant, from theſe Items, make out the poor Man's Bill, conſidering farther, that $4\frac{4}{11}$ oz. is the Weight of a Cubic Inch of Lead?

69. MENSURATION of SOLIDS.

PROBLEM XIII.

To find the Solidity of a Cube, Priſm, or Right Cylinder.

Fig. 12.

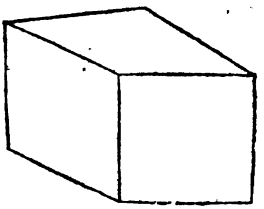


Fig. 13.

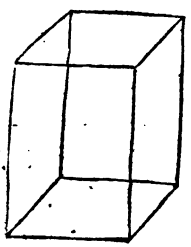
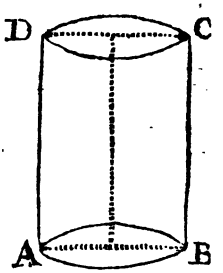


Fig. 14.



RULE.

Multiply the Area of the Baſe into the Height or Altitude, and the Product will be the Solidity.

EXAMPLES.

1. What is the ſolid Content of a Cube, whoſe Side is $2\frac{1}{2}$ Feet?
2. How many Ale Gallons of Water will a Ciſtern hold, whoſe Length, Breadth, and Depth, are 4 Feet 9 Inches, 3 Feet 6 Inches, and 2 Feet 10 Inches?
3. What is the Content of a Cylinder, whoſe Diameter is $4\frac{1}{2}$ Feet, and 8 Feet high?

PROBLEM

PROBLEM XIV.

To find the convex Surface of a Priſm, or a right Cylinder.

A GENERAL RULE.

Find the Area of each Side and End ſeparately, then Add thoſe Areas together, and their Sum will be the whole Surface of any Priſm or Body whatever.

A PARTICULAR RULE.

Multiply the Circumference of the Baſe by the Altitude of the Cylinder, and the Product will give the convex Surface.

EXAMPLE.

4. What is the convex Surface of a right Cylinder, whoſe Circumference is $10\frac{1}{2}$ Feet, and Height $7\frac{1}{4}$ Feet.

PROBLEM XV.

To find the Solidity of a Pyramid, or right Cone.

Fig. 15.

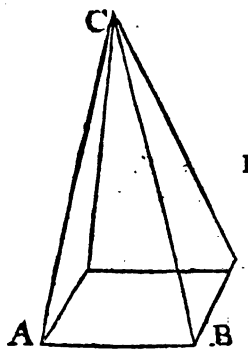
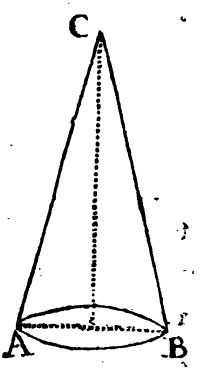


Fig. 16.



RULE.

Multiply the Area of the Baſe by a third Part of the Altitude, and the Product will be the Content required.

EXAMPLES.

EXAMPLES.

5. Required the Solidity of a ſquare Pyramid, each Side of whoſe Baſe is 12 Feet, and the ſlant Height 25 Feet?
6. What is the ſolid Content of a triangular Pyramid, whoſe Height is 30 Feet, and each Side of its Baſe $5\frac{1}{2}$?
7. What is the Solidity of a Cone, whoſe Baſe is $3\frac{1}{4}$ Feet Diameter, and Altitude 6 Feet?

PROBLEM XVI.

To find the convex Surface of a Pyramid, or Cone, (as Fig. 15. and 16.)

RULE.

Multiply the Perimeter or Circumference of the Baſe by the ſlant Height or Length of the Side (AC) and Half the Product will be the Area.

EXAMPLES.

8. What is the Surface of a triangular Pyramid, including the Baſe, the ſlant Height being 20 Feet, and each Side of the Baſe $3\frac{1}{4}$?
9. What is the convex Surface of a right Cone, whoſe Baſe is 45 Feet in Circumference, and ſlant Side is 20 Feet in Length?

PROBLEM XVII.

To find the Solidity of a Fruſtum of a Pyramid or Cone.

Fig. 17.

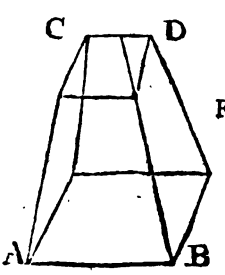
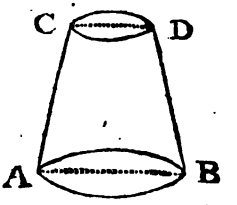


Fig. 18.



Add into one Sum the Areas of the two Ends, and the mean Proportional between them; multiply the Sum by the perpen-

perpendicular Height, and $\frac{1}{3}$ of the Product will be the Solidity; that is, if A be the Area of the greater End, and a of the leſſer, and b the Height.

Then $A+a+\sqrt{Aa}\times\frac{1}{3}b=$ the Solidity.

EXAMPLES.

10. How many ſolid Feet are there in a Tree, whoſe Baſes are Squares, each Side of the one being 15 Inches, and each Side of the other 6, and the Length Meaſures along the Side 24 Feet?
11. What is the Content of the Fruſtum of a Cone 60 Feet high, the Diameter of its Ends being 20 and 3 Feet?
12. How many ſolid Feet are there in a Conical Fruſtum, the Circumferences of whoſe Baſes are 66 and 56 Feet, Height is 4 Feet?

PROBLEM XVIII.

To find the convex Surface of the Fruſtum of a Pyramid or right Cone.

RULE.

Multiply the Sum of the Perimeters or Circumference of the Ends, by the ſlant Height, and Half the Product will be the Surface required.

EXAMPLES.

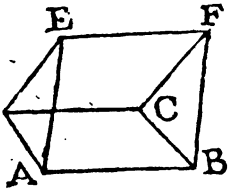
13. How many ſquare Feet are in the Surface of a Fruſtum or a ſquare Pyramid, whoſe ſlant Height is 10 Feet, each Side of the greater Baſes being 3 Feet 4 Inches, and each Side of the leſs 2 Feet 2 Inches?
14. How many ſquare Feet are in the Surface of a Fruſtum of a Cone, whoſe Circumference of its Ends are 32 and 8 Feet, and ſlant Side 7 Feet?
15. If a Segment of 6 Feet ſlant Height be cut off a Cone, whoſe ſlant Height is 30 Feet, and the Circumference of its Baſe 10 Feet, what will be the Surface of the Fruſtum?

PROBLEM

PROBLEM XIX

To find the Solidity of a Cuneus or Wedge.

Fig. 19.



RULE.

Multiply the Area of the Baſe, A D E, or B C F, by Half the Altitude, D C, of the Wedge, and the Product will give the Solidity.

Thus, $AD \times DE \times \frac{CD}{2} =$ the Solidity.

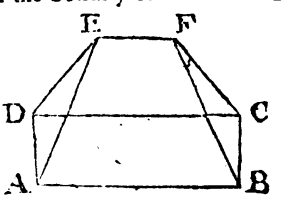
EXAMPLE.

16. What is the Solidity of a Wedge, whoſe Baſe meaſures 30 Feet by 16, and whoſe Height is 12?

PROBLEM XX.

To find the Solidity of a Pavilion Roof.

Fig. 20.



RULE.

To the Length of the Ridge, add twice the Side of the Baſe, which is parallel to it: Multiply the Sum by the other Side of the Baſe, and the Product which ariſes by a ſixth Part of the Altitude, and the ſecond Product will give the Solidity.

Thus, $\overline{EF+2AB} \times BC \times \frac{alt}{6}$

EXAMPLE.

17. What is the Solidity of a Pavilion Roof, whoſe Baſe is 36 by 20, Ridge parallel to the greateſt Side 16, and Altitude 12 Feet?

PROBLEM XXI.

To find the Solidity of the Fruſtum of a ſquare Pyramid, made by a Section Parallel to the Baſe.

RULE.

To the Areas of the Ends add the Product of their Sides, multiply the Sum by a third Part of the Altitude, and the Product will give the Solidity.

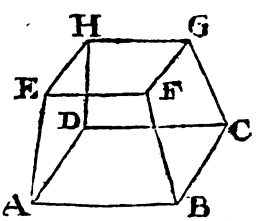
EXAMPLE.

18. What is the Solidity of the Fruſtum of a Pyramid 60 Feet high, whoſe Ends are 16 and 12 Feet ſquare?

PROBLEM XXII.

To find the Solidity of a Priſmoid.

Fig. 21.



RULE.

To the Area of the Ends, add the Product of the Sums of the Lengths and Breadths; multiply this Sum by a ſixth Part of the Altitude, and the Product will give the Solidity.

Thus, $AB \times BC + EF \times FG + \overline{AB + EF} \times \overline{BC + FG} + \frac{alt.}{6}$

EXAMPLE.

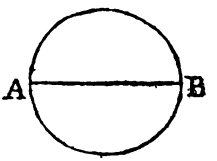
EXAMPLE.

19. What is the ſolid Content of a Canal 304 Feet by 20 at Top, 300 Feet by 16 at Bottom, and 5 Feet deep?

PROBLEM XXIII.

To find the Surface of a Sphere or Globe, or of any Segment or Zone of it.

Fig. 22.



A GENERAL RULE.

Multiply the Circumference of the Sphere into the Diameter or Height of the Part required, and the Product will be the curve Surface, whether it be Segment, Zone, Hemiſphere, or the whole Sphere.

Note.—The Height of the whole Sphere is its Diameter.

PARTICULAR RULES.

1. Find the Circumference of a great Circle upon the Globe, by Prob. VI. Rule I. or by multiplying the Radius by 6,2832, multiply the Circumference by the Diameter, and the Product will give the Superficies.—Or,

2. Multiply 3,1416 by the Square of the Diameter, and the Product will give the Superficies.

EXAMPLES.

20. What is the Surface of a Globe, whoſe Diameter is 7?
21. What is the Surface of a Globe, whoſe Semi-Diameter is 6 Inches?
22. If the Diameter or Axis of the Earth be 7957½ Miles, what is the whole Surface, ſuppoſing it a perfect Sphere?
23. What is the Superficies of a Segment 9 Feet high, cut from a Globe of 42 Feet Diameter

PROBLEM XXIV.

To find the Solidity or Content of a Sphere or Globe. (See Fig. to Prob. XXIII.)

RULES.

1. Find the Superficies by the laſt Problem, multiply the Superficies by $\frac{1}{3}$ of the Radius, or by $\frac{1}{6}$ of the Diameter, and the Product will be the Solidity.—Or,

2. Multiply the Cube of the Diameter by ,5236, and the Product will give the Solidity; that is,

$\frac{3.1416}{6}$ =,5236, the Solidity.—Or,

3. Find the Content of a circumſcribing Cylinder, by Problem XIII. and take $\frac{2}{3}$ of it for the Content of the Globe.

For a Globe is $\frac{2}{3}$ of its circumſcribing Cylinder, and ,5236 is the Content of a Globe whoſe Diameter is 1.

EXAMPLES.

24. What is the Content of a Globe whoſe Diameter is 7?

25. Suppoſe the Earth to be ſpherical, and its Diameter 7957$\frac{1}{2}$ Miles, what is its Solidity?

PROBLEM XXV.

To find the Solidity of the Segment of a Globe. (See Fig. 23.)

RULES.

1. From three Times the Diameter of the Globe, take twice the Altitude of Segment; multiply together the Remainder, the Square of the Altitude, and 0,5236, and this Product will give the Solidity.

Thus, let b=CD the Height of the Segment, and d the Diameter.

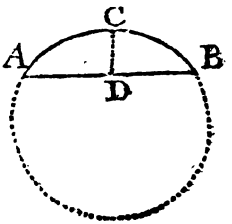
Then, $3d-2b\times,5236\times bb$= the Solidity of ACB.

2. To three Times the Square of the Radius of its Baſe, add the Square of its Height; multiply the Sum by the Height, and that Product again by ,5236, will give the Solidity.

That

That is, if r=AD, the Radius of its Baſe, b=CD, the Height. Then $,5236b \times 3rr \times hb$= the Solidity of the Segment A B C.

Fig. 23.



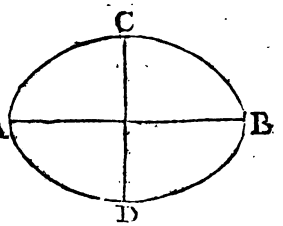
E X A M P L E.

26. What is the Solidity of a Segment 4 Feet high, cut from a Globe 18 Feet Diameter?

P R O B L E M XXVI.

To find the ſolid Content of a Spheroid.

Fig. 24.



R U L E I.

Multiply continually together the fixed Axis, the Square of the revolving Axis, and the Number ,5236, (being $\frac{1}{6}$ of 3,14159 nearly) and the laſt Product will be the Content required; that is, if p=3,14159, &c. t= the Tranſverſe, and c= the conjugate Axis of the generating Ellipſe.

Then $\frac{1}{6}ptte$= the oblate,
And $\frac{1}{6}ptcc$= the oblong Spheroid.

RULE II.

Multiply the Area of the generating Ellipſe by $\frac{2}{3}$ of the revolving Axis, and the Product will be the Content of the Spheroid.

Let A= the Area of the Ellipſe, then from the former Rule,
$\frac{2}{3}t$A= the Oblate,
And $\frac{2}{3}c$A= the oblong Spheroid.

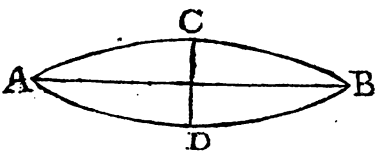
EXAMPLE.

27. What is the ſolid Content of a Spheroid, whoſe Diameter of the greateſt Circle is 33 Inches, and the Length 55 Inches?

PROBLEM XXVII.

To find the Solidity of a Parabolic Spindle.

Fig. 25.



RULES.

1. The Square of the Diameter (CD) of the greateſt Circle, multiplied by ,41888, (being $\frac{8}{15}$ of ,7854) and that Product again by its Length (AB) will be the Solidity.

2. Multiply the Area of the greateſt Circle, or middle Section, by the Length, and $\frac{8}{15}$ of the Product will be the Content.

That is, if AB= the Length or Axis DE= the greateſt Diameter, or double the Abſciſſa of the generating Parabola ACB, and π=,785398, or ,7854. Then $\frac{8}{15}\pi \times DC^2 \times AB$= the whole Solid. ADBCA.

EXAMPLE.

28. What is the Solidity of a Parabolic Spindle, whoſe greateſt Diameter is 36, and its Length 99 Inches?

PROBLEM

PROBLEM XXVIII.

To meaſure TIMBER.

A ſquare Piece of Timber, equally thick at both Ends, is a Priſm; a round Piece, equally thick at both Ends, is a Cylinder; a ſquare Piece, that tapers regularly, is the Fruſtum of a Pyramid; and a round Piece, that tapers regularly, is the Fruſtum of a Cone: and the Contents of theſe Solids may be exactly computed by their reſpective Rules.

But becauſe the Menſuration of tapering Timber by the exact Rules is troubleſome, an Approximation has taken Place, and the Contents of ſuch Trees are generally computed by the following

RULE.

Multiply the Square of the Quarter Girt (or $\frac{1}{4}$ of the Circumference) in Inches, by the Length in Feet, divide the Product by 144, and the Quotient will be the Content in Feet.

But to find the Content more near the Truth, obſerve the following

RULE.

Multiply the Square of $\frac{1}{5}$ of the Girt or Circumference by twice the Length, and the Product will be the Content, extremely near the Truth.

REMARKS.

1. The Girt of a Piece of Timber is its Compaſs or Circumference at the Middle, $\frac{1}{4}$ of which is commonly taken for the Side of a Square, equal to the Area of the Section there.
2. Trees of regular Growth muſt be meaſured in Parts or Pieces, as above directed.
3. Allowance muſt be made for the Thickneſs of Bark (if on the Tree) in Oak $\frac{1}{10}$ or $\frac{1}{12}$, in other Wood not ſo much.
4. When the Timber is to be reduced to Loads,

Divide the Feet in $\left\{\begin{matrix}\text{rough}\\\text{hewn,}\end{matrix}\right\}$ by $\left\{\begin{matrix}40\\50\end{matrix}\right\}$ gives the Load.

As 40 Feet make one Load of rough Timber, and 50 one of hewn.

EXAMPLES.

EXAMPLES.

29. What is the Content of a Tree, whoſe Girt is 42 Inches, and Length 16 Feet?
30. What is the Content of a Tree, whoſe Compaſs is 64 Inches, and the Length 30½ Feet?
31. How many Loads of Timber are there in a hewn Tree, whoſe Breadth is 42 Inches, Depth 30 Inches, and Length 40 Feet?

GAUGING.

PROBLEM XXIX.

To find the Area of any Triangular, Tun, Back, Cooler, or circular and elliptical Superficies in Ale Gallons, &c.

RULES.

1. Find the Area in Inches by the different Problems in Sect. 75, and the Solidity by Sect. 76, then,

$$\text{Divide by } \left\{\begin{matrix}282\\231\\268.8\end{matrix}\right\} \text{ for } \left\{\begin{matrix}\text{Ale.}\\\text{Wine.}\\\text{Corn.}\end{matrix}\right.$$

and the Quotient will be the Area in Gallons.—Or,

2. If the Square of the Diameter of any Circle.

$$\text{Divide by } \left\{\begin{matrix}359.05\\294.12\\342.24\end{matrix}\right\} \text{ for } \left\{\begin{matrix}\text{Ale Gallon.}\\\text{Wine Gallon.}\\\text{Corn Gallon.}\end{matrix}\right.$$

the Quotient will be the Area in their reſpective Gallons.

For as ,785398 : 1 : : 282, the Square of the Diameter of the Circle, whoſe Area is 282 cubic Inches, viz. one Ale Gallon, and from this Proportion ariſes the preceding Diviſions:

$$\text{Viz. } \left\{\begin{matrix}282\\231\\268.8\end{matrix}\right\} \div ,785398 = \left\{\begin{matrix}359.05.\\294.12.\\342.24.\end{matrix}\right.$$

Or, theſe Diviſors may be turned into Multiplicators, by dividing Unity or 1, or rather, by dividing the Area in Inches of that Circle, whoſe Diameter is 1.

That is, ,785398, by 282, &c.

$$\text{Thus, } ,785398 \div \left\{\begin{matrix}282 = ,002785.\\231 = ,003399.\\268.8 = ,002922.\end{matrix}\right.$$

The

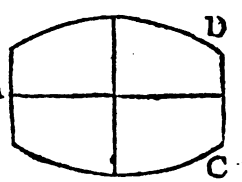
The Product will be the Area in Gallons of the ſame Name.

EXAMPLES.

32. Suppoſe the Length of a Brewer's Tun, Back or Cooler, be 16 Feet 6 Inches, and its Breadth 7 Feet 4 Inches, what will be the Area in Ale or Beer Gallons, &c.?
33. The Length of the Baſe of a Triangular Cooler is 94 Inches, and its perpendicular Breadth is 58 Feet 6 Inches: Required its Area in Ale Gallons?
34. Suppoſe the longeſt Diameter of a Brewer's Veſſel be 84.5 Inches, and the ſhorteſt Diameter to be 50 Inches, what will be the Area in Ale Gallons?
35. Suppoſe a Tun in the Form of the Fruſtum of a Pyramid, whoſe Baſes are equilateral Triangles, let the Side of the Top be 64 Inches, the Side of the Bottom be 98.6 Inches, and its Height or Depth 36 Inches, what is the Content of that Tun in Ale Gallons, &c.?
36. If the Diameter of the Baſe of a regular Cone is 60.5 Inches, and the perpendicular Height is 42.8 Inches, what will be the Content in Ale Gallons, &c.?
37. Suppoſe the Diameter of a Fruſtum of a Cone be 84 Inches at the Top, and the Diameter at the Bottom to be 62 Inches, and the Height 42 Inches, required the Content in Ale Gallons?

The Bung Diameter E F, Head Diameter C D, and Length of the Caſk A B (within Side) being given; to find the Content of a Cylinder nearly equal to it.

Fig. 26.



RULES.

1. To twice the Area of the Circle at the Bung, add the Area of the Circle of the Head, multiply the Sum by one-

one-third of the Length of the Caſk, the Product is the Content in Cubic Inches, which are converted into Gallons: by dividing by 282 for Ale, and 231 for Wine Gallons.—Or,

2. To the Square of the Head Diameter, add twice that of the Bung Diameter, and from that Sum take $\frac{2}{5}$ of the Square of the Difference of the ſaid Diameters; then multiply the Remainder by the Length of the Caſk; then if the Product be multiplied

by $\left\{\begin{matrix}.00092837=,002785\\.0011333=,003399\end{matrix}\right\}\div 3$, will give the Area.

Or divided $\left\{\begin{matrix}1077,15=359.05\\882,36=294.12\end{matrix}\right\}\times 3$, will give the Area.

EXAMPLES.

38. What is the Content of a Caſk, whoſe Bung Diameter, Head Diameter, and Length is 32, 26, and 40 Inches within Side reſpectively?

39. Suppoſe the Bung Diameter of a Caſk to be 40 Inches, Head 36, and Length 64, required the Content both in Ale and Wine Gallons?

QUESTIONS for EXERCISE in MENSURATION of SOLIDS.

1. What is the Difference between a ſolid half Foot, and half a Foot ſolid?

2. What is the Proportion, in Space, between a Room 25 Feet 6 Inches long, 20 Feet 2 Inches broad, 14 Feet high, and two others of juſt half the Dimenſions?

3. Another Room is 17 Feet 7 Inches long within, 13 Feet 10 Inches broad, and $9\frac{1}{2}$ Feet high; it has a Chimney carried up ſtraight in the Angle, the Plan whereof is juſt the Half of $5\frac{1}{2}$ Feet, by 4 Feet 2 Inches: The Queſtion is, How many Cubic Feet of Air the ſame will contain, allowing the Content of the Fire Place and Windows at 4 ſolid Yards?

4. A Ship's Hold is $112\frac{1}{2}$ Feet long, 32 broad, and $5\frac{1}{2}$ Feet deep; how many Bales of Goods, 3 Feet 4 Inches long, 2 Feet 2 Inches broad, and 3 Feet deep, may be ſtowed therein, leaving a Gang-Way, the Whole $4\frac{1}{2}$ Feet broad?

5. I want a rectangular Ciſtern, that is 16lb. to the Foot ſquare, ſhall weigh juſt a Fodder of Lead; it muſt be 8 Feet long, and $4\frac{1}{4}$ over; how many Hogſheads,

Wine

Wine Meaſure, will this Ciſtern contain, taking it at $\frac{1}{4}$ of an Inch from the Top?

6. A Log of Timber is $18\frac{1}{2}$ Feet long, 18 Inches broad, and 14 Inches thick, die ſquare all through; now if 2 ſolid Feet and half be ſawed off the End, how long will the Piece then be?
7. The ſolid Content of a ſquare Stone is found to be $126\frac{1}{4}$ Feet, its Length is $8\frac{1}{3}$ Feet: What is the Area of one End, and what the Depth, if the Breadth aſſigned be $38\frac{1}{2}$ Inches?
8. The Dimenſions of the circular Wincheſter Buſhel are $18\frac{1}{2}$ Inches over, and 8 Inches deep: How many Quarters of Grain will a ſquare Bin hold that Meaſures 7 Feet 10 Inches long, 3 Feet 10 broad, and 4 Feet 2 Inches deep within?
9. Taking the Dimenſions of the Buſhel as above, what muſt the Diameter of a circular Meaſure be, which at 12 Inches deep will hold 9 Buſhels of Sea Coal ſtruck?
10. A Priſm of two equal Baſes, and ſix equal Sides, that meaſures 28 Inches acroſs the Center, from Corner to Corner; the ſuperficial and the ſolid Content is required, taking the Length at 134 Inches?
11. I have a rolling Stone 44 Inches in Circumference, and am to cut off three Cubic Feet from one End; whereabouts muſt the Section be made?
12. I would have a Syringe, $1\frac{1}{4}$ Inch in the Bore, to hold a Pint (Wine Meaſure) of any Fluid; what muſt the Length of the Piſton, ſufficient to make an Injection with it, be?
13. I would have a Cubic Bin made capable of receiving juſt $13\frac{1}{2}$ Quarters of Wheat, Wincheſter Meaſure; what will be the Length of one of its Sides?
14. A Bath Stone, 20 Inches long, 15 over, and 8 deep, weighs 220 lb. how many Cubic Feet thereof will freight a Ship 290 Tons?
15. The common Way of meaſuring Timber being to girt a round ſtrait Tree in the Middle, and to take $\frac{1}{4}$ of the Girt for the Side of a Square, equal to the Area of the Section there; if this be not conſidered in the Price appointed, pray on which Side lies the Advantage?
16. The ſolid Content of a Globe 20 Inches in Diameter, a Cylinder of the ſame Diameter, 20 Inches long, and a Cone

a Cone 20 Inches Diameter at the Baſe, and 20 Inches high, are ſeverally required; and alſo what they will coſt painting, at 8*d.* per Yard?

17. Our Satellite, the Moon, is a Globe, in Diameter 2170 Miles: I require how many Quarters of Wheat ſhe would contain, if hollow, $2150\frac{2}{5}$ ſolid Inches being the Buſhel; and how much yard-wide Stuff would make her a Waiſtcoat, was ſhe to be cloathed?

18. Suppoſe the Atmoſphere, or Body of the Air, and Vapours ſurrounding the Globe of the Earth and Sea to be 60 Miles above the Surface, and the Earth is 7970 Miles in Diameter; how many Cubic Yards of Air then hang about, and revolve along with this Planet?

19. A ſquare Pyramid, whoſe Sides at the Baſe meaſure 10 Inches a piece, and is 20 Feet high by the Slope in the Middle of each Side of the Baſe, is to be ſold at 7*s.* per ſolid Foot; and if the poliſhing the Surface of the Sides will be 8*d.* per Foot more, I would know the Coſt of this Stone when finiſhed?

20. A round Maſh-Vat meaſures at the Top 72 Inches over within, at the Bottom 54, the perpendicular Depth being 42 Inches, the Content in Ale Gallons is required?

21. The Shaft of a round Pillar, 16 Inches in Diameter at the Top, is about 8 of the Bottom Diameters in Height, $\frac{1}{3}$ whereof is truly cylindrical, and the other $\frac{2}{3}$ ſwelling, but we will ſuppoſe it tapers ſtrait, and that it is $\frac{1}{6}$ leſs at the Top than at Bottom; the Price of the Stone and Workmanſhip is fought, at 3*s.* 6*d.* per Cubic Foot, and farther the ſuperficial Content, including both Ends?

22. A Stick of ſquare Timber tapers ſtrait; the Side of the greater End is $19\frac{1}{2}$ Inches, at the leſs $13\frac{1}{2}$ Inches, the Length 16 Feet 6 Inches; the Value, at 2*s.* 6*d.* per Foot ſolid, is demanded?

23. What Quantity of Brandy will the Diſtiller's Tun contain, that meaſures 40 Inches within at the Head, 52 at the Bung, and 100 Inches long; and how many Barrels of London Ale would fill it?

24. Suppoſe the Globe or Ball, on the Top of St. Paul's Church, to be 6 Feet in Diameter; what did the gilding thereof come to, at $3\frac{1}{2}$*d.* per Inch ſquare?

25. The famous Tun of Heidelburgh, that being heretofore annually repleniſhed with Rheniſh, had in it ſome Wine that

that was many Ages old, before the French demoliſhed it in the late War; it was 31 Feet in Length, and 21 in Diameter, and pretty nearly cylindrical: Pray how many Tuns of Wine would the ſame contain?

70. SPECIFIC GRAVITY of METALS.

The ſpecific Gravity of a Body, is the Relation that the Weight of a Body of one Kind hath to the Weight of an equal Magnitude of a Body of another Kind; the Knowledge of which is of great Uſe in computing the Weights of ſuch Bodies as are too unweildy to have their Weight diſcovered by other Means.

The following TABLE ſhews the ſpecific Gravity to Rain Water, of Metals, and other Bodies; and the Weight of a Cubic Inch of each, in Parts of a Pound Avoirdupoiſe, and of Ounces Troy, and Parts of an Ounce.

BODIES.	Sp. Grav.	wt. lb. Avoir.	wt. oz. Troy.
Fine Gold	19,640	0,7103587	10,459273
Standard Gold	9,520	0,7060185	9,962625
Coaſt Gold	18,838	0,6828703	9,911707
Quick Silver	13,762	0,4976574	7,384411
Lead	11,313	0,4091696	5,984010
Fine Silver	11,091	0,4011501	5,850035
Standard Silver	10,629	0,3844400	5,556769
Caſt Silver	10,528	0,3807870	5,503967
Copper	8,769	0,3171658	4,747121
Platę Braſs	8,350	0,2942593	4,404273
Caſt Braſs	8,104	0,2929832	4,272409
Steel	7,850	0,2839265	4,142127
Bar Iron	7,704	0,2808159	4,031361
Block Tin	7,238	0,2417901	3,861519
Caſt Iron	7,135	0,2580647	3,806568
Load Stone	5,106	0,1846788	2,724083
Blue Slate	3,500	0,1264914	1,867272
Veined Marble	2,702	0,0977286	1,429411
Common Glaſs	2,600	0,0940393	1,360841
Flint Stone	2,582	0,0933883	1,351419
Portland Stone	2,570	0,0929543	1,345139
Free Stone	2,352	0,0915788	1,231038
Brick	2,000	0,0723379	1,046801

BODIES.	Sp. Grav.	wt. lb. Avoir.	wt. oz. Troy.
Alabaſter	1,888	0,0683061	0,988456
Ivory } Horn }	1,832	0,0662606	0,958489
Brimſtone	1,800	0,0651042	1,949424
Clay	1,712	0,0619213	0,902498
Lignum Vitæ	1,327	0,0479862	0,699936
Coal	1,255	0,0553921	0,661959
Pitch	1,150	0,0415943	0,606759
Mahogany Wood	1,063	0,0384475	0,560691
Dry Box Wood	1,030	0,0372530	0,543282
Milk } Sea-Water }	1,033	0,0372530	0,543742
Rain-Water	1,000	0,0361690	0,527458
Red Wine	0,993	0,0359158	0,523766
Bees Wax	0,995	0,0359881	0,524820
Linſeed Oil	0,932	0,0337095	0,491591
Proof Spirits } or Brandy }	0,927	0,0335503	0,489268
Dry Oak	0,915	0,0330946	0,489008
Olive Oil	0,913	0,0330222	0,481569
Beech	0,854	0,0308883	0,450449
Dry Elm } Dry Aſh }	0,800	0,0289352	0,421966
Dry Wainſcot	0,747	0,0270182	0,394011
Dry Yellow Fir	0,657	0,0237630	0,346539
Cedar	0,613	0,0221715	0,323332
Dry White Deal	0,569	0,0205801	0,300123
Cork	0,240	0,0186805	0,126590
Air	0,0012	0,0000434	0,000633

CASE I.

The linear Dimenſions, or Solidity of any Body being given, to find its Weight.

RULE.

Multiply the Cubic Inches contained in that Body by the Tabular Weight correſponding, will give the Weight, in Pounds Avoirdupoiſe, or Ounces Troy.

EXAMPLES.

EXAMPLES.

1. What is the Weight of a Piece of Oak, of a rectangular Form, whose Solidity is 12096 Cubic Inches?
2. What is the Weight of a Piece of Fir, whose Girt is 20 Inches, and Length 40 Feet?
3. What is the Weight of an Iron Shot, of 7 Inches Diameter?
4. What is the Weight of an Iron Shot, weighing 42lb. Avoirdupoise?
5. What is the Weight of an Iron Bomb Shell, of 3 Inches thick, the greatest Diameter being 16 Inches?
6. Required the Weight of one of the Portland Key Stones, to the middle Arch of Westminster-Bridge, the Diameter of the Arch being 76 Feet, the Height of the Key Stone 5 Feet, the Chord of its greatest Breadth, to the Front of the Arch, 3 Feet 4 Inches, and its Depth of the Arch 4 Feet?
7. In the Walls of Balbec, in Turkey, there are three Stones laid End to End, now in Sight, that measure in Length 61 Yards; one of which in particular is 63 Feet long. 12 Feet thick, and ½ Yards over: Now if this Block was Marble, what Power would balance it, so as to prepare it for moving?

CASE II.

The Weight of any Body being given, to find the Solidity and the specific Gravity thereof.

RULE.

Divide the given Weight by the Tabular Weight corresponding to the Name of the same Kind, and the Quotient will be the Solidity in cubic Inches.

EXAMPLES.

8. What will a Block of Marble, weighing 8 Tons, 14 cwt. come to, at 6*s.* per Foot solid?
9. Suppose that a Man of War, with all its Ordnance, Rigging, and Appointment, draws so much Water as to displace 1300 Tuns of Sea Water, London Beer measure: The Weight of the Vessel is required?

10. What will a chain of ſtandard Gold weigh in Water that raiſes a Fluid an Inch, in a Veſſel three Inches ſquare, when put into it; and ſuppoſing the Workman had adulterated the ſaid Chain with $14\frac{1}{2}$ Ounces of Silver, how much higher would the Water, upon its Immerſion, be raiſed in the Veſſel?

11. Hiero, King of Sicily, ordered his Jeweller to make him a Crown, containing 63 Ounces of Gold; the Workmen thought of ſubſtituting part Silver therein, to have a proper Perquiſite, which taking Air, Archimedes was appointed to examine it, who, on putting it into a Veſſel of Water, found it raiſed the Fluid, or that itſelf contained 8,2245 Cubic Inches of Metal, and having diſcovered that the Cubic Inch of Gold more critically weighed 10,36 Ounces, and that of Silver but 5,85 Ounces, he, by Calculation, found what Part of his Majeſty's Gold had been changed, and you are deſired to repeat the Proceſs?

THE

THE

TUTOR's GUIDE.

PART V.

71. CHRONOLOGY

IS the Art of eſtimating and comparing together the Times when any memorable Tranſaction hath happened, ſuch as related in Hiſtory, whether civil or eccleſiaſtical.

It alſo takes a View of the various Facts, Calendars, and Methods of computing Time, practiſed by different Nations, compares them together, and ſettles ſuch Order and Harmony among them, that the exact Time in which any remarkable Event happened may be certainly known.

	Years of the World.	Years before Chriſt.
Some have dated their Events from the Creation of the World —	0000	4004
Others from the Deluge or Flood —	1656	2348
The Greeks from their Olympiads of 4 Years each — —	3228	776
The Romans from the Building of Rome	3251	753
The Aſtronomers from Nabonaſſar King of Babylon — —	5257	747
Some Hiſtorians from the Death of Alexander the Great — —	3676	328
We From the Birth of Chriſt —		A. D.
The Mahometans from the Flight of Mahomet, and called the Hégira	4626	622

PROBLEM I.

To find whether any given Year be Leap Year.

RULE.

Divide the given Year by 4, if 0 remains, it is Leap Year, but if 1, 2, 3, remains, it is ſo many Years after.

EXAMPLES.

1. Is 1779 Leap Year?
2. Is 1780 Leap Year?

Note 1.—Every fourth Year is Leap Year, ſo called from leaping or advancing a Day more that Year than any other; that Year has then 366 Days in it, and February 29.

PROBLEM II.

To find the Dominical Letter till the Year 1800.

RULE.

To the given Year, add its fourth Part, omitting Fractions, divide that Sum by 7, the Remainder taken from 7, leaves the Index of the Letter in the common Year's Reckoning.

1	2	3	4	5	6	7
A	B	C	D	E	F	G

But in Leap Years, this Letter and its preceding one (in the retrograde Order which theſe Letters take) are the Dominical Letters.

EXAMPLES.

3. For the Year 1786, I demand the Dominical Letter?
4. For the Year 1788, I demand the Dominical Letter?

2. The Dominical Letter, is that Letter of the Alphabet which points out in the Calendar the Sundays throughout the Year; thence alſo called the Sunday Letter: Of theſe Letters are conſequently ſeven before mentioned, beginning with the firſt Letter of the Alphabet; and, as in Leap Year there is an intercalary Day, there are then two, one ſerving January and February, and its following Letter the remaining Part of the Year.

PROBLEM

PROBLEM III.

To know on what day in the Week any propoſed Day of the Month will fall.

RULE.

Firſt find the Dominical Letter, then the Day of the Week the firſt of the propoſed Months fall on, which is known by the two following Lines:

At Dover dwell George Brown, Eſquire,
Good Chriſtopher Finch, and David Frier.

Where the firſt Letter of each Word anſwers to the Letter belonging to the firſt Day of the Months in order, from January to December.

3. You muſt obſerve that the 1ſt, 8th, 15th, 22d, and 29th Day of any Month falls on the ſame Day of the Week.

EXAMPLES.

5. In 1786, on what Day of the Week does the 19th of May fall, it being Queen Charlotte's Birth-Day?
6. On what Day of the Week does the 4th of June fall in 1788, being King George the Third's Birth-Day?

PROBLEM IV.

To find the Year of the Solar, Lunar, or Golden Number, and Indiction Cycles.

RULE.

To the given Year add 9 for the Solar, 1 for the Lunar, 3 for the Indiction, divide the Sums in order by 28, 19, and 15, the Remainder in each ſhews the Year of its reſpective Cycle.

EXAMPLE.

7. Required the Year of the Solar, Lunar, and Indiction, Cycles, for the Years 1786 and 1788?

4. The Solar Cycle, or the Cycle of the Sun, is a Period of 28 Years; in which Time all the Varieties of the

the Dominical Letters will have happened, and the 29th Year the Cycle begins again, when the ſame Order of the Letters will return as were 28 Years before.

At the Birth of Chriſt, nine Years had paſſed in this Cycle.

The Lunar Cycle, or Cycle of the Moon, or Golden Number, is a Period of 19 Years, containing all the Variations of the Days on which the new and full Moons happen, after which Time they fall on the ſame Days they did 19 Years before, and ſhe begins again with the Sun.

But when a Centiſſimal or Hundredth Year falls in the Cycle, the new and full Moon, according to the new Stile, will fall a Day later than otherwiſe. The birth of Chriſt happened in the ſecond Year of this Cycle.

The Roman Indiction is a Cycle of 15 Years, which firſt began the third Year before Chriſt.

PROBLEM V.

To find the Epact till the Year 1900.

RULE.

Multiply the Golden Number for the given Year by 11, divide that Product by 30, and from the Remainder take 11, leaves the Epact. If the Remainder is leſs than 11, add 19 to it, and the Sum will be the Epact.

EXAMPLES.

8. Find the Epact for the Year 1788.
9. Required the Epact for the Year 1786?

5. The Epact of any Year is the Moon's Age, at the Beginning of that Year, that is, the Days paſt ſince the laſt new Moon.

PROBLEM VI.

To find the Moon's Age.

RULE.

To the Epact, add the Number and Day of the Month, their Sum, if under 30, is the Moon's Age. But if that Sum

Sum is above 30, the Exceſs in Months of 31 Days, or the Exceſs above 29, in a Month of 30 Days, ſhews the Age, or Day ſince the laſt Conjunction.

The Moon's Age taken from 30, leaves the Day of the next new Moon.

When the Solar and Lunar Cycles begin together, the Moon's Age on the firſt of each Month, or the Monthly Epacts, are called the Numbers of the Month, and are as follows, viz.

For	Jan.	Feb.	Mar.	April.	May.	June.
Theſe	0.	2.	1.	2.	3.	4.
For	July.	Aug.	Sep.	Oct.	Nov.	Decem.
Theſe	5.	6.	7.	8.	9.	10.

EXAMPLES.

10. Required the Moon's Age on May 21, 1788?
11. What is the Moon's Age on the 24th of March, 1786?

6. The Moon's Age is how many Days are paſt ſince the Day of her Change, which Age never exceeds 30 Days.

PROBLEM VII.

To find when Eaſter-Day will happen.

RULE.

Find on what Day of March the new Moon falls neareſt to the 21ſt in common Years, or neareſt the 20th in Leap Years, then the Sunday next after the full, or 15th Day of that new Moon, will be Eaſter-Day.

If the 15th Day falls on a Sunday, the next Sunday is Eaſter-Day.

EXAMPLES.

12. On what Day does Eaſter-Sunday fall for the Year 1788?
13. Required the Time of Eaſter-Day for the Year 1786?

7. Eaſter is the Time when Chriſtians celebrated the Reſurrection of Chriſt from the Grave, and took its Riſe from Eaſtra, the name of the Saxon Deity or Goddeſs, whoſe Feſtival was celebrated about this Time of the Year, and after its Aboliſhment by Chriſtianity, the Name was retained, and is to this Day uſed to ſignify the Feſtival of Chriſt's Reſurrection, as mentioned above.

PROBLEM VIII.

To find the Time of the Moon's Southing.

RULE.

Multiply the Moon's Age by 4, divide the Product by 5, quotes the Hours, and the Remainder, multiplied by 12, gives the additional Minutes.

If this Time is leſs than 12 Hours, it is the Time of Southing after Mid-Day; but if greater, 12 Hours taken from it, leaves the Southing after Midnight.

EXAMPLES.

14. Required the Time of the Moon's Southing at London, on the 21ſt of May, 1788?

15. At what Time does the Moon come to the Meridian at Briſtol Key, on March 24, 1786?

8. The Moon's Southing at any Place, is the Time when ſhe comes to the Meridian, or is full South of that Place, which is every Day later, by about 48 Minutes, occaſioned by the Hours in a Day being divided by the 30 Times ſhe paſſes the Meridian from new Moon to new Moon.

PROBLEM IX.

To find the Time of High Water at any Place.

RULE.

To the Time of the Moon's Southing, add the Time the Moon has paſſed the Meridian to make High Water at that Place, and the Sum will ſhew the Time of High Water.

The

The Diſtance of the Moon from the Meridian when High Water at the following Places, is, at London, ☽ bears N. E. or S. E. 3h. 0m. Briſtol Key ☽ bears E. by S. and W. by N. 6h. 45m.

EXAMPLES.

16. On the 21ſt of May, 1788, at what Time is it High Water at London?
17. On the 24th of March, 1786, at what Time is it High Water at Briſtol Key?

10. High Water is the State of the Tide when higheſt, or the Time it ceaſes to flow up.

QUESTIONS for Exerciſe at Leiſure Hours.

1. England was conquered by William I. October 4, 1066; his Son, William II. came to the Crown Sept. 9, 1087, and left it Auguſt 2, 1100; William III. received it Feb. 3, 1689, and died March 8, 1701: How many Days did each of theſe Princes govern, reſpect being had to the intercalary Days, and to February every Leap Year, as they roſe in the Courſe of Time?
2. Richard I. ſucceeded his Father Henry II. July 7, 1189; John his Brother ſucceeds him April 6, 1199; Richard II. ſucceeded Edward III. on the 21ſt of June, 1377, and was depoſed by Henry IV. on the 30th of September, 1399; Richard III. cauſed his Nephew, Edward V. and his Brother, to be murdered, on the 18th of June, 1483, and was ſlain himſelf on the 22d of Auguſt, 1485: How many Days was the Realm governed by the three Richards, reſpect being ſtill had to the intercalary Days as they happened?
3. The firſt Queen Mary came to the Crown July 8, 1553; ſhe reigned 5 Years, 4 Months, and 9 Days; her Siſter Elizabeth ſucceeded, and James I. came to the Throne the 14th of March, 1602, who left it to his Son, Charles I. on the 27th of March, 1625, who was forced from it January 30, 1648: The Queſtion is, How many Days did theſe Princes reign, and at the Death of Charles I. how long had England been under

an

an uninterrupted Succeſſion of Proteſtant Princes, Mary the Firſt being the laſt profeſſed Papiſt that enjoyed the Crown, not neglecting the intercalary Days in February as before?

4. A Grant was made Feb. 14, in the 10th of Henry I. who began his Reign Auguſt 2, 1100; it was reſumed Nov. 19, in the 4th of Henry III. who came to the Crown October 19, 1215; it was received the 16th Day of July, in the 13th of Henry VII. who aſcended the Throne Auguſt 22, 1486; but it was a ſecond Time revoked and finally ſuppreſſed, in the 16th of his Succeſſor, Henry VIII. on the 10th of May: Now as this Man's Father died July 21, 1509, the Queſtion is, How many Days was this Grant in Force, and how many did it lie dormant?

79. GEOGRAPHY.

EXAMPLES on the TERRESTRIAL GLOBE, or MAPS.

1. What is the Latitude and Longitude of Pekin, in China, and Cape Horn?
2. Required the Name of that Place whoſe Latitude is 18° N. and Longitude 76½ W. alſo of another Place, whoſe Latitude is 34½° S. and Longitude 16½ E.?
3. What is the Difference of Latitude between London and Naples; alſo between the Iſland of Barbadoes, and the Cape of Good Hope?
4. Required the Diſtance (in Engliſh Miles) Jamaica is from London; alſo the Names of all thoſe Places that are at the ſame Diſtance from London as Rome is?
5. Required the Sun's Declination, Right Aſcenſion, and Meridian Altitude, on the 20th of May?
6. Required the Time of the Sun's riſing and ſetting, on the 20th of May; alſo his Amplitude at the ſame Time? Likewiſe when the Twilight begins and ends?
7. What is the Sun's Azimuth and Altitude, on the 20th of May, at 4 o'Clock in the Afternoon?
8. What is the Angle of Poſition, or Bearing of Port Royal in Jamaica, from London; and on the contrary, London from Port Royal?

9. When

9. When it is Noon, or Twelve o'Clock, at London, what o'Clock is it at Pekin in China; alſo at what Places are they breakfaſting, dining, and ſupping, ſuppoſe they breakfaſt at 7 o'Clock, dine at 1, and ſup at a Quarter after 9?
10. What Places are thoſe to which the Sun is vertical on the 2d of May?
11. On what two Days in the Year will the Sun be vertical to Candy, in the Iſle of Ceylon?
12. What Places are thoſe in the North Frigid Zone, to which the Sun begins to ſhine conſtantly without ſetting, on the 20th of May?
13. On what Day doth the Sun begin to ſhine conſtantly, without ſetting, at the Cherry Iſland, whoſe Lat. is 74° North; and how long?
14. What Places are thoſe to which the Sun is riſing, ſetting, or in the Meridian; alſo thoſe Places which are enlightened, and thoſe which are not, on the 20th of May, at 8 in the Morning?
15. By the Almanack for this preſent Year, on the ——— at ——— will happen an Eclipſe of the Sun; I demand to know to what Part of the Globe the ſame will be viſible?
16. On the 3d of June, 1769, in the Afternoon, happened a Tranſit of Venus over the Sun; the Beginning of this Tranſit was at 7 h. 13 m. Middle 10 h. 35 m. End 1 h. 55 m. I demand to know where the Beginning, Middle, and End thereof, was viſible?
17. In what Latitude is the longeſt Day 20 Hours long?
18. What Inhabitants of the Earth are thoſe called Antoeci, Perioeci, and Antipodes, with reſpect to London?
19. What is the Sun's Declination on the 20th of June by the Analemma, without knowing a Place?
20. It is required to find by the Analemma, the Sun's Place in the Ecliptic and right Aſcenſion, on the 12th of May?
21. Required to find by the Analemma, the Time of the Sun's riſing and ſetting, with an Amplitude on the 30th of March?
22. What is the Sun's Altitude and Azimuth for the 26th of April, at 10 in the Morning by the Analemma?

23. On the 24th of April in the Morning, in Lat. 51° 30′ N. the Sun's Altitude was 26°, required the Hour and Azimuth, by the Analemma?
24. Suppoſe a Ship ſails from a Part A. in Lat. 38°, to another Part B. in Lat. 5° N. and then finds her Difference of Longitude 43°: Required her Courſe and diſtance ſailed?
25. A Ship ſails from a Part A. in Lat. 26° N. to another Part B. in Lat. 20 S. upon a Courſe of 46°: Required the Difference of Longitude, and Diſtance ſailed?
26. Suppoſe a Ship ſails from a Part A. in Lat. 51° 30′ to another Part B. in Lat. 18, Diſtance 2226 Miles, required the Difference of Longitude and Angle of the Courſe?
27. Suppoſe a Ship ſails from a Place A. in Lat. 51°, on a Courſe, making an Angle with Meridian of 40°, till the Difference of Longitude be found to be 20: Required the Difference of Latitude, and Diſtance ſailed?
28. A Ship from the Latitude 47° 30′ N. has ſailed S. W. by S. 1980 Miles: Required the Difference of Latitude and Longitude?

EXAMPLES on the CELESTIAL GLOBE.

1. Required the Time of the Sun's riſing and ſetting; alſo, the Beginning and End of the Crepuſculum, or Twilight, on the 21ſt of June?
2. What is the Moon's diurnal Motion in the Ecliptic? alſo at what Time doth ſhe Riſe, Set, and come to the Meridian, on the 20th of May?
3. Required the Latitude of the Moon, and her Declination, on the 20th of May?
4. At what Time doth the Planet Jupiter Riſe, Culminate, and Set, on the 20th of May; alſo, what its right Aſcenſion, Declination, Amplitude, and Azimuth, on the above Day?
5. What is the Right Aſcenſion, Declination, Latitude, and Longitude of Pollux?
6. What Star is that whoſe right Aſcenſion is 65° 30″, and its Declination 12° 15′ 30″ North; alſo what Time doth it Riſe, come to the Meridian, Set, and what

what is its Amplitude on the 20th of July, in the Lat. of London?

7. On what Day of the Year will the Star Arcturus riſe and ſet Coſmically, at London?
8. Required the Time when Procyon and Canis Minor, will riſe and ſet acronically at London?
9. On what Day of the Year will Altayr Culminate, or come to the Meridian with the Sun?
10. At what Time of the Year will the Pleiades, or Seven Stars, be upon the Meridian at Midnight?
11. What is the oblique Aſcenſion of Sirius, and what is the Time of its Continuance above the Horizon of London?
12. What is the Altitude and Azimuth of Capella, on the 20th of May, at 10 o'Clock at Night, in the Latitude of London?
13. The Altitude of Cor Leonis, on the 22d of May, at London was 20, required the Hour of the Night?
14. A Perſon being in a certain Place, on the 20th of May, at ¼ after 3 in the Morning, obſerved the Pleiades were then riſing; required the Latitude of the Place of obſervation?
15. On the 11th of May, in the Latitude 51°, 30', the two Stars, Luci a Lyræ, and Altyar, will both be on the ſame Azimuth: Required the Hour of the Night?
16. On the 11th of May (Lat. as before) the bright Star marked in Pegaſus's Wing, and that in the Head of Andromeda, will both have an equal Altitude; required the Hour?
17. A Perſon being at Sea, found, by Obſervation, that Sirius was then upon the Miridian, and Arcturus riſing; required the Lat. of the Place of Obſervation?
18. Another Perſon being at a certain Place, found, by Obſervation, Cor Hydræ and Procyon are both on the Azimuth of 78° 45' S. E. one with 5° of Altitude, and the other with 35°: Required the Latitude of the Place of Obſervation?
19. To what Latitude, South, muſt I travel, to loſe Sight of the Star Capella?
20. Repreſent the Face of the Heavens on the Globe, on the 20th of May, at 10 at Night?

21. By an Obſervation made at Jamaica of a Comet, on the 31ſt of March, 1759, at 5 o'Clock in the Morning, its Altitude was found to be 22° 50′, and Azimuth 71° South Eaſt. Another Obſervation was made at London on the 6th of May, 1759, at 10 at Night, of the ſame Comet, and then its Altitude was found to be 16°, and its Azimuth 37° S. W. It is required to know the Place of the Comet at each Obſervation?

22. Required the Time of the above Comet's riſing, ſouthing, and ſetting at London, on the 31ſt of March 1759; alſo its Latitude, Longitude, Declination, and Aſcenſion?

23. Required the apparent Path among the fixed Stars in the Heavens, of the above Comet; alſo its Velocity?

Note.—Theſe Problems are anſwered by Mr. Hill's Twelve-Inch Globes.

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TUTOR's GUIDE.

PART V.

73. ALGEBRA.

ALGEBRA is a Kind of Specious Arithmetic, or an Arithmetic in Letters; and is that Science which teaches, in a general Manner, the Compariſon of abſtract Quantities; by Means whereof, ſuch Queſtions are reſolved whoſe Solutions would be ſought in vain from common Arithmetic.

Here every Quantity, whether given or required, is commonly repreſented by ſome Letter of the Alphabet; the known or given Quantities, for Diſtinction Sake, being noted by the firſt Letters, *a*, *b*, *c*, *d*, &c. and the unknown Ones by the laſt Letters, *x*, *y*, *z*, &c.

There are, moreover, in Algebra, certain Signs or Notes, made uſe of to ſhew the Relation and Dependence of Quantities one upon another, whoſe Signification the Learner ought firſt of all to be made acquainted with. (See the Characters for Abbreviation next before Page 1.)

74. ADDITION.

Addition in Algebra, is performed by connecting the Quantities by their proper Signs, and joining in any Sum such as can be united.

For performing which obſerve the following

RULES.

1. If the Quantities to be added are alike, and have the ſame Sign, add the Coefficients together, and to their Sum prefix the common Sign, and adjoin the common Letter or Letters.

2. If the Quantities to be added are alike, but have unlike Signs, add together the Coefficients of the affirmative Terms (if there be more than one) and do the ſame by the negative ones, and to their Difference prefix the Sign of the greater, adding the common Letter or Letters.

3. If the Quantities to be added are unlike, write them down after the other, with their proper Signs and Coefficients prefixed.

EXAMPLES.

(1) To $6a+7b-3c$
Add $10d+b-7c$

(2) $ab-6b+4x+10y-15z+6$
$6ab-b+x+4y-9z+3$

(3) To $-6b-7c-8x$
$+4b+9c+5x$

(4) $6a-6x+7y-10$
$-6a+6x-4y+13$

(5) To $4a+6b+4c-6$
Add $-4x-7y+4z$

(6) $2a-6bc$
$6x+10$

(7) To $10a\sqrt{bc}$
Add $6a\sqrt{bcc}$

(8) $a\sqrt{bb+cc}$
$4\sqrt{bb+cc}$

(9) $b+3\sqrt{aa-x}$
$b-3\sqrt{aa-x}$

75. SUBTRACTION.

Subtraction of Algebra is performed by the following general

RULE.

Change the Signs of the Quantity to be ſubtracted into their contrary Signs, and then add it, ſo changed, to the Quantity from which it was to be ſubtracted (by the Rule of Addition) the Sum ariſing will be the Remainder.

EXAMPLES.

(1) From $3a$ / $-3a$

(2) $2a-4x+7y-7$ / $6a+4x+7y+4$

(3) $6b-4c+4x.$ / $7b+7c-9x.$

(4) From $10a \surd bc$ / $6a \surd bc$

(5) $6b \surd aa+xx$ / $4b \surd aa+xx$

(6) $b+a$ / $a-\surd cc-aa$

76. MULTIPLICATION.

Multiplication of Algebra is alſo performed by the following general

RULE.

Multiply the Coefficients (if any) together, as in Sect. 4. and to their Product join the Letters, and prefix the proper Sign before them, which, when the Signs of the Factors are alike, that is, both $+$, or both $-$, the Sign of the Product is more; but when the Signs of the Factors are unlike, the Sign of the Product is $-$.

EXAMPLES.

(1) Mul. $a+c$ / By b

(2) $-a-b-c$ / $-d$

(3) $x+y+z.$ / a

(4) Mul. $-8x$ / $-4a$

(5) $12x+6y$ / $4a$

(6) $-6d.$ / $+7b.$

(7) Mul.

(7) Mul. $4x-5y+z$
By $-6f$

(8) $2a-4b$
$2a+4b$

(9) $aa+ab+bb$
$a-b$

(10) Mul. $xx-ax$
By $x+a$

(11) $xx+xy+yy$
$xx-xy+yy$

(12) Mul. $aaa-3aab+3ab-bbb$
By $aa-2ab+bb$

(13) $\sqrt{bc+dcc}$
$\sqrt{ac}$

(14) Mul. $\sqrt{xx+zz}$
By $\sqrt{xx-zz}$
Prod.

(15) $6cd\sqrt{b+ad}$.
$3a\sqrt{ca}$.

77. DIVISION.

Diviſion of Algebra Quantities is the direct Contrary to that of Multiplication, and conſequently performed by direct contrary Operations.

RULES.

1. When the Quantities in the Dividend have like Signs of thoſe in the Diviſor, and no Co-efficient in either, caſt off all the Quantities in the Dividend, that are like thoſe in the Diviſor, and ſet down the other Quantities with the Sign $+$ for the Quotient.

2. When the Quantities in the Dividend have unlike Signs to thoſe in the Diviſor, then ſet down the Quotient Quantities found as in the laſt Rule with the Sign $-$ before them.

3. If the Quantities in the Diviſor cannot be exactly found in the Dividend, then ſet them both down like a Vulgar Fraction, and find all the Quantities of the ſame Letters that are in the Dividend and Diviſor, and proceed with the Co-efficients, as in Caſe I. Sect. 36.

4. If

4. If the Quantity to be divided is compound, range its Parts according to the Dimenſions of ſome one of its Letters, and proceed as in Sect. V.

5. Different Powers or Roots of the ſame Quantity are divided by ſubtracting the Exponent of the Diviſor from that of the Dividend, and place the Remainder as an Exponent to the Quantity given.

EXAMPLES.

Diviſor. Dividend.

(1.) $d)ad+6d($ (2.) $-d)-ad-bd($ (3.) $a)aa+ab($
(4.) $-a)ab($ (5.) $b)-ab-bd($ (6.) $-bc)abc+bcd+bcf($
(7.) $7b)42db($ (8.) $2bx)8abx-18bxc($ (9.) $2b)ab+bb($
(10.) $20a)10ab+15ac($
(11.) $a-b)aaa-3aab+3abb-bbb($
(12.) $a+b)aa+2ab+bb($ (13. $a+b)aa-bb($
(14.) $3a-6)6a^4-96($
(15.) $3x^2-4x+5)18x^4-45x^3+82x^2-67x+40($
(16.) $4z-5a)48x^3z-76ax^2-64a^2x+105a^3($
(17.) $3x+4a)81x^4-256a^4($
(18.) $2x-3a)16^4x-72a^2x^2+81a^4($
(19.) $2xy\sqrt{z})4xy\sqrt{xzz}($
(20.) $20\sqrt{2cy}60ab\sqrt{10acxy}($
(21.) $x^2)x^5($ (22.) $\overline{a+x}^{\frac{1}{4}})\overline{a+x}^{7}($

78. FRACTIONS.

Reduction of Algebraic Fractions are of the ſame Nature, and require the ſame Management as thoſe of Numbers.

A mixt Quantity is reduced to an improper Fraction by the Rules in Sect. 36, Caſe 3.

EXAMPLES.

1. Reduce $a-x+\frac{a^2-ax}{x}$ to an improper Fraction.

2. Reduce $a+b+\frac{x}{z}$ to an improper Fraction.

3. Reduce $a-x+\frac{aa-ax}{x}$ to an improper Fraction.

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An improper Fraction is reduced to a mixt Quantity, by the Rule in Sect. 36, Case IV.

EXAMPLES.

4. Reduce $\frac{a^2-x^2}{x}$ to a mixt Quantity.

5. Reduce $\frac{az+bz+x}{z}$ to a mixt Quantity.

6. Reduce $\frac{ax-xx+aa-ax}{x}$ to a mixt Quantity.

Fractions of different Denominations are reduced to Fractions of equal Value, and to have the same Denominator by the Rule in Sect. 38, Case V.

EXAMPLES.

7. Reduce $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$, to a common Denominator.

8. Reduce $\frac{b+c}{a+b}$ and $\frac{d-e}{b-d}$ into one Denomination.

Fractional Quantities are reduced into their lowest Terms by the Rule in Sect. 38, Case I.

EXAMPLES.

9. Reduce $\frac{aaa-abb}{aa+2ab+bb}$ to its lowest Terms.

10. Reduce $\frac{25az}{5xz+15az}$, and $\frac{aaa+bbb}{aa-bb}$, to their lowest Terms.

The Rules for Addition, Subtraction, Multiplication, and Division of Algebraic Fractions, are the same as for Numerical Fractions; see Sect. 36, 37, 38, and 39.

EXAMPLES in ADDITION.

1 Add $\frac{a}{b}+\frac{c}{d}$ and $\frac{d}{c}$ into one Sum.

2. Add

2. Add $\frac{a-b+d}{d+a}$, and $\frac{a+b-d}{d+a}$ together.

3. Add $\frac{2a-b}{d+c}$, and $\frac{2b-a}{a+c}$ together.

4. Add $\frac{a+b}{d}$ to $\frac{2a+c}{d}$.

EXAMPLES in SUBTRACTION.

(1.) From $\frac{x}{2}$ take $\frac{x}{3}$. (2.) From $\frac{a+x}{b}$ take $\frac{a-x}{c}$.

(3.) From $\frac{bb+aa}{c}$ take $\frac{bb}{c}$. (4.) From $\frac{2b}{a+d}$ take $\frac{a+b-d}{a+d}$.

EXAMPLES in MULTIPLICATION.

1. Mul. $\frac{a+b}{c}$ by $\frac{a-b}{d}$. 2. Mul. $a+\frac{b}{c}$ by $\frac{d}{e}$.

3. Mul. $\frac{3a-2b}{2d+c}$ by $\frac{4a+2b}{d}$.

4. Mul. $2a+\frac{b}{c}-25$ by $36+4c$.

EXAMPLES in DIVISION.

1. Divide $\frac{acd+ba}{cd}$ by $\frac{d}{c}$. 2. Divide $\frac{a-b}{a}$ by $\frac{a+b}{a-b}$.

3. Divide $a+\frac{b}{c}$ by $d+\frac{e}{f}$. 4. Divide $\frac{ab}{c}$ by $\frac{1}{c}$.

79. IN-

79. INVOLUTION.

Involution is the raiſing of any given Quantity to any propoſed Power.

1. If the Quantity propoſed to be involved has no Index, that is, if it be not itſelf a Power or a Surd, the Power thereof will be repreſented by the ſame Quantity under the given Index or Exponent.

Thus, the Cube or third Power of x, is expreſſed by x^3.

And the ſixth Power, $a+z$, by $\overline{a+z}|^6$, &c.

2. But if the Quantity propoſed be itſelf a Power or Surd, it will be involved by multiplying its Exponents by the Exponent of the propoſed Power.

Thus, the fifth Power of x^2 is x^{10}, the fourth Power of $\overline{ax+y}|^3$ is $\overline{ax+y}|^{12}$, and the third Power of $\overline{a-x}|^{\frac{1}{2}}$ is $\overline{a-x}|^{\frac{3}{2}}$.

3. A Quantity compoſed of ſeveral Factors, multiplied together, is involved by raiſing each Factor to the Power propoſed.

Thus, the Square or ſecond Power of ax is a^2x^2, the Cube or third Power of $2ax$ is $8a^3x^3$; the fourth Power of $4\times\overline{aa-xx}\times\overline{a+b+c}$ is $16\times\overline{aa-}|\times\overline{a+b+c}|^4$, and the Square of the radical Quantity $a^{\frac{1}{2}}\times a+x^{\frac{1}{3}}$ is $\overline{a\times a+x}|^{\frac{2}{3}}$.

4. A Fraction is involved by raiſing both the Numerator and the Denominator to the Power propoſed.

Thus, the Cube or third Power of $\frac{a}{b}$ is $\frac{aaa}{bbb}$, and the fourth Power of $\frac{2a^2x}{3b^2}$ is $\frac{8a^8x^4}{81b^6}$; likewiſe the ſixth Power of $\frac{\overline{aa+xx}|^{\frac{1}{2}}}{\overline{a-x}|^{\frac{1}{3}}}$ is $\frac{\overline{aa-x}|^3}{\overline{a-x}|^2}$

5. Quantities compounded of ſeveral Terms, are involved by a continual Multiplication of all their Parts.

Thus $a+b\times a+b=a^2+2ab+^2b$.

EXAMPLES.

EXAMPLES.

1. Involve or raiſe x to the fourth Power.
2. Raiſe $\overline{ax+z}^2$ to the fifth Power.
3. Involve $3x^3z^2$ to the third Power.
4. Involve $\frac{5ab}{2c}$ to the ſixth Power.
5. Involve or raiſe $a+b$ to the ſixth Power, this is called a Binomial Root.
6. Involve or raiſe $a-b$ the ſixth Power, this is called a Reſidual Root.

There is a Rule or Theorem, given by Sir Iſaac Newton, whereby any Power of a Binomial, or $x-y$, may be expreſſed in ſimple Terms, without the Trouble of thoſe tedious Multiplications which are required otherwiſe.

Theo. $1\times\frac{m-0}{1}\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times\frac{m-4}{5}\times\frac{m-5}{6}\times$, &c.

Note, m is the Exponent of the Power, that is, $m=7$, in the ſeventh Power, 6 in the ſixth Power, &c.

So that if $x-y$ is to be raiſed to any Power m, the Terms, without their Co-efficients, will be

$x^m, x^{m-1}, x^{m-2}y, x^{m-3}y, x^{m-4}y, x^{m-5}y, x^{m-6}y$, &c. continued till the Exponent of y becomes equal to m.

And the Co-efficients of the reſpective Terms will be

$1, m, m\times\frac{m-1}{2}, m\times\frac{m-1}{2}\times\frac{m-2}{3}, m\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}$

$m\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times\frac{m-4}{5} m\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times$

$\frac{m-4}{5}\times\frac{m-5}{6}\times\frac{m-6}{xy6}+$, &c.

So by this Theorem any Quantity, conſiſting of two Terms, is raiſed to any Power m, with great Eaſe and Perſpicuity, and will be of great Service to the young Algebraiſt, if properly demonſtrated to him by his Tutor.

80. EVOLUTION.

Evolution, or the Extraction of Roots, being directly the contrary to Involution, or raising of Powers, is performed by converse Operations, viz. by the Division of Indices, as Involution was by their Multiplication.

Thus, the Square Root of x^6, is x^3, the Cube Root x^6 is x^2, also the biquadratic Root of $\overline{x+y}|^8$, will be $\overline{x+y}|^2$; and the Cube Root of $\overline{xx-yy}|^2$ will be $\overline{xx-yy}|^{\frac{2}{3}}$. Moreover the Square Root of $\overline{xx-yy}|^{\frac{1}{2}}$ will be $\overline{xx-yy}|^{\frac{1}{4}}$, its Cube Root $\overline{xx-yy}|^{\frac{3}{6}}$, and its Biquadratic Root $\overline{xx-yy}|^{\frac{1}{8}}$, and so of others.

Evolution of Compound Quantities is performed by the following

RULE.

First, place the several Terms, whereof the given Quantity is composed, in order, according to the Dimensions of some Letter therein, as shall be judged most commodious; then let the Root of the first Term be found, and placed in the Quotient, which Term being subtracted, let the first Term of the Remainder be brought down, and divided by twice the first Term of the Quotient, or by three Times its Square, or four Times its Cube, &c. according as the Root to be extracted is a Square, Cubic, or Biquadratic one, &c. and let the Quantity thence arising be also wrote down upon the Quotient; and the Whole be raised to second, third, or fourth, &c. Power, according to the aforesaid Cases respectively, and subtracted from the given Quantity, and if any Thing remains, let the Operation be repeated, by always dividing the first Term of the Remainder by the same Divisor, found as above.

EXAMPLES.

1. It is required to extract the Square Root of $x^2+2xy+y^2$?
2. It is required to extract the Square Root of $x^2-2xy+y^2$?
3. It is required to extract the Square Root of $x^4-2x^3y+3x^2y^2-2xy^3+y^4$?

4. Extract

4. Extract the Cube Root of $x^3-6x^2y+12xy^2+8y^3$?
5. Extract the Biquadratic Root of $16x^4-96x^3y+216x^2y^2-216xy^3+81y^4$?

81. INVOLUTION of SURD QUANTITIES.

1. When the Surds are not joined to radical Quantities, they are involved to the ſame Height as their Index denotes, by taking away their radical Sign.

Thus, $\sqrt{xx}$ will be x, and $\sqrt{xx+yy}$ will be x^2+y^2, &c.

2. When Surds are joined to rational Quantities, involve the rational Quantities to the ſame Height as the Index of the Surd denotes; then multiply the involved Quantities into the Surd Quantities, after the radical Sign is taken away, as before.

Thus, $x\sqrt{yy}$, will be x^2y^2, and $4x\sqrt{xx+yy}$, will become $16x^4+16x^2y^2$, likewiſe, $2x^3\sqrt{x+y^2}$, will become $8x^5+8x^3y^2$, &c.

82. EQUATIONS.

An Equation is, when two equal Quantities, differently expreſſed, are compared together, by means of the Sign $=$ placed between them.

REDUCTION of SINGLE EQUATIONS.

RULES.

1. Any Term of an Equation may be tranſpoſed to the contrary Side, if its Sign be changed.

Thus, $x+12=20$, then will $x=20-12=8$.

2. If there is any Quantity by which all the Terms of an Equation are multiplied, let them all be divided by that Quantity, but, if all of them be divided by any Quantity, let the common Diviſor be caſt away.

Thus, $ax=ab$, then will $x=\frac{b}{a}$; alſo, if $\frac{x}{b}=\frac{a}{b}$, $x=a$, by the latter Part of the Rule.

3. If there are irreducible Fractions, let the whole Equation be multiplied by the Product of all their Denomi-

nators, or which is the ſame, let the Numerator of every Term in the Equation be multiplied by all the Denominators except its own, ſuppoſing ſuch Terms (if any there be) that ſtand without a Denominator, to have an Unit ſubſcribed.

Thus $x+\frac{x}{2}+\frac{x}{3}=11$, reduced is $6x+3x+2x=66$, or $x=$

6. per Rule 5. Again, $\frac{2x}{3}+12=\frac{4x}{5}+6$, this reduced will become $10x+180=12x+90$; then per Rule 1, $x=45$.

4. If in your Equation there is an irreducible Surd, wherein the unknown Quantity enters, let all the other Terms be tranſpoſed to the contrary Side, (by Rule I.) and then if both Sides be involved to the Power denominated by the Surds, an Equation will ariſe free from radical Quantities, unleſs there happens to be more Surds than one, in which caſe the Operation is to be repeated.

Thus $\sqrt{x+4}=12$, by Tranſpoſition becomes $\sqrt{x}=12-4=8$; which, by ſquaring both Sides, gives $x=64$.

So, likewiſe, $\sqrt{aa+xx}-c=b$, becomes $\sqrt{aa+xx}=b+c$, ſquared, gives $aa-xx=bb+2cb+cc$, then per Rule 1, $x^2=a^2+b^2+2cd+c^2$, and $x=\sqrt{a^2+b^2+2cd+c^2}$

5. Having, by the preceding Rules, if there is Occaſion, cleared your Equation of fractional and radical quantities, and ſo ordered it, by Tranſpoſition, that all the Terms wherein the known Quantities are found, may ſtand on the ſame Side thereof, let the Whole be divided by the Co-efficients, or the Sum of the Co-efficients of the higheſt Power of the ſaid unknown Quantity.

Thus, if $6x=24$; then will $x=\frac{24}{6}=4$; and if $4x=48-2x$, then will $6x=48$, per Rule 1, and $x=\frac{84}{6}=8$.

EXAMPLES.

EXAMPLES.

For the Learner's Exercise in the aforegoing Rules, set down promiscuously,

1. If $20-3x-8=60-7x$, what is the Value of x?

2. When $5x-16=3x+12$, what is x?

3. If $\frac{3x}{4}+5=\frac{5x}{6}+2$, what is x equal to?

4. If $\frac{7x}{8}-5=\frac{9x}{10}-8$, what is x?

5. When $\frac{5x}{9}-8=74-\frac{7x}{12}$, quere x?

6. If $56-\frac{3x}{4}=48-\frac{5x}{8}$, what is the Value of x?

7. Required the Value of x, when $36-\frac{4x}{9}=8$?

8. When $\frac{2x}{3}=\frac{176-4x}{5}$, quere x?

9. If $\frac{45}{2x+3}=4\frac{57}{4x-5}$, what is the Value of x?

10. If $\frac{42x}{x-2}=\frac{35x}{x-3}$, what is x equal to?

11. If $\frac{xx-12}{3}=\frac{xx-4}{4}$, what is x equal to?

12. When $\frac{5xx}{16}=8+12$, what is the Value of x?

13. Suppoſe $\frac{x+1}{2}+\frac{x+2}{3}=16-\frac{x+3}{4}$, quere x?

14. Suppoſe $ax+b^2=\frac{ax^2+ac^2}{a+x}$, quere x?

15. If $\sqrt{\frac{5x}{3}+12}=17$, what is x?

16. What is the Value of x, when $\sqrt{12+x}=2+\sqrt{x}$?

17. If $\sqrt{x}+\sqrt{a+x}=\sqrt{\frac{2a}{a+x}}$, what is x?

18. Suppoſe $615x-7xxx=48x$, quere x?

19. Suppoſe $\sqrt{a^2+x^2}=\sqrt{b^4+x^4}$, what is x equal to?

82. Of the EXTERMINATION of UNKNOWN QUANTITIES; or, the REDUCTION of two or more EQUATIONS to a Single One.

RULE.

1. Obſerve which of all your unknown Quantities is the leaſt involved, and let the Value of that Quantity be found in each Equation, (by the Rules already given) looking upon all the Reſt as known; let the Values thus found be put equal to each other, (for they are equal) becauſe they all expreſs the ſame Thing; whence new Equations will ariſe, out of which that Quantity will be totally excluded, with which new Equations the Operations may be repeated, and the unknown Quantities exterminated, one by one, till at laſt you come to an Equation containing only one unknown Quantity.

Thus, Let the given Equations be $x+y=12$, and $5x+3y=50$, to find x and y.

Now

Now by tranſpoſing y and $3y$ we get $x=12-y$, and $5x=50-3y$, from the laſt of which Equation, $x=\frac{50-3y}{5}$

Now by equating theſe two Values of x, we have $12-y=\frac{50-3y}{5}$, and therefore $60-5y=50-3y$, from which, $y=\frac{10}{2}=5$, and $x=12-y=12-5=7$.

2. Or, let the Value of the unknown Quantity, which you would firſt exterminate, be found in that Equation wherein it is the leaſt involved, conſidering all the other Quantities as known; and let this Value and its Powers be ſubſtituted for that Quantity and its reſpective Powers in the other Equation, and with the new Equations thus ariſing, repeat the Operation, till you have only one unknown Quantity and one Equation.

Thus, x being the firſt Equation, (in the laſt Example) $=12-y$, then by ſubſtituting this Value of x, in the ſecond, that is $60-5y$, muſt be wrote in the Room of its Equal $5x$; whence will be had, $60-5y+=50$; and from hence $y=\frac{10}{2}=5$, as before.

3. Or, laſtly, let the given Equations be multiplied or divided by ſuch Numbers or Quantities, whether known or unknown, that the Term which involves the higheſt Power of the unknown Quantity to be exterminated, may be the ſame in each Equation, and then, by adding, or ſubtracting the Equations, as Occaſion ſhall require, that Term ſhall vaniſh, and a new Equation emerge, wherein the Number of Dimenſions, (if not the Number of unknown Quantities) will be diminiſhed.

By multiplying the firſt Equation by 5, we ſhall have — — — $5x+5y=60$
from whence ſubtracting the 2d Equation, viz. $5x+3y=50$
there remains — — — $2y=10$
whence

whence $y=5$, and x by the firſt or ſecond Equation will be 7, ſtill the ſame as before.

The firſt of theſe three Ways, is the moſt commonly uſed, but the laſt of them is, for the general Part, the moſt eaſy and expeditious in Practice.

EXAMPLES.

1. Let $\left\{\begin{matrix}5x+8y=106\\4x-5y=5\end{matrix}\right\}$ quere, the Value of x and y?

2. Let $\left\{\begin{matrix}5x-3y=150\\10x+15y=825\end{matrix}\right\}$ quere, x and y?

3. Let $\left\{\begin{matrix}\frac{x}{2}+\frac{y}{3}+\frac{z}{4}=62\\\frac{x}{3}+\frac{y}{4}+\frac{z}{5}=47\\\frac{x}{4}+\frac{y}{5}+\frac{z}{6}=38\end{matrix}\right\}$ quere, x, y, and z?

4. Let $\left\{\begin{matrix}\frac{x}{4}+\frac{y}{5}=15\\\frac{x}{6}+\frac{y}{9}=9\end{matrix}\right\}$ quere, x and y?

5. Given $\left\{\begin{matrix}\frac{x}{2}-12=\frac{y}{4}+8\\\frac{x+y}{5}+\frac{x}{3}-8=\frac{2y-x}{4}+27\end{matrix}\right\}$ what is the Value of x and y?

6. Given $\left\{\begin{matrix}x+y=80\\x+z=70\\y+x=60\end{matrix}\right\}$ to find x, y, and z?

7. Suppoſe $\left\{\begin{matrix}x+100=y+z\\y+100=2x+2z\\z+100=3x+3y\end{matrix}\right\}$ what is x, y, and z equal to?

8. Let there be given $x-y=2$, $xy+5x-6y=120$, to exterminate x?

9. Let $\left\{\begin{matrix}x+y=s\\x^2-y^2=d\end{matrix}\right\}$ quere, x, y, and z?

10. Let $\left\{\begin{matrix}x+y+z=12\\x+2y+3z=20\\\frac{x}{3}+\frac{y}{2}+z=6\end{matrix}\right\}$ quere, x, y, and z?

83. QUA-

83. QUADRATIC EQUATIONS.

A quadratic Equation is, when it involves one unknown Quantity, and at the ſame Time the Square of that Quantity, and the Product of it multiplied by ſome unknown Quantity.

Of theſe Equations there are three Forms, viz.

$xx+6x+12=52$ the firſt Form.
$2xx-6x+12=20$ ſecond.
$6x9-x=8$ third.

All of which may be ſolved by the following

RULES.

1. Tranſpoſe all the Terms that involve the unknown Quantity to one Side, and the known Terms to the other Side of the Equation.
2. If the Square of the unknown Quantity is multiplied by any Co-efficient, you are to divide all the Terms by that Co-efficient, that the Co-efficient of the Square of the unknown Quantity may be Unit.
3. Add to both Sides the Square of half the Co-efficient prefixed to the unknown Quantity itſelf, and the Side of the Equation that involves the unknown Quantity will then be a complete Square.
4. Extract the Square Root from both Sides of the Equation, which you will find on one Side always to be the unknown Quantity with Half the aforeſaid Co-efficient ſubjoined to it, ſo that by tranſpoſing this Half, you may obtain the Value of the unknown Quantity expreſſed in the known Term.

Thus, by Rule 1, the three aforeſaid Equations will become as follows:

Firſt $xx+6x=52-12=40$
Second $2x^2-6x=20-12=8$
And Third $x^2-6x=-8$

And by Rule 2, the ſecond Equation will become $xx-\frac{6x}{2}=\frac{8}{2}$, conſequently $x^2-3x=4$.

Then,

Then, by Rule 3, theſe three Equations will become as follows, viz.

Firſt $x^2+6x+9=40+9=49$
Second $x^2-3x+2,25=4+2,25=4=6,25$
And Third $x^2-6x+9=9-8=1$

Alſo, by Rule 4, they will become as follows,

Firſt $x+3=\sqrt{49}=7$
Second $x-1,5=\sqrt{6,25}=2,5$
And Third $x-3=\sqrt{1}=1$

Then by the Rules of Reduction,

$$\left.\begin{array}{l} x=7-3=4 \\ x=2,5+1,5=4 \\ x=1+3=4 \end{array}\right\} \text{ſo, } x=4.$$

All Quadratic Equations may be ſolved by the following general Theorem.

Thus, ſuppoſe the ſecond Equation was required to be reſolved.

Firſt let $A=2$, $B=6$, and $C=8$.
Then it will ſtand $Axx-Bx=C$.
Per Rule 2, $xx-\frac{Bx}{A}=\frac{C}{A}$

Alſo, per Rule 3, $xx-\frac{bx}{a}+\frac{bb}{4aa}=\frac{bb}{4aa}+\frac{c}{a}$, but the two Fractions $\frac{bb}{4aa}$ and $\frac{c}{a}$, when thrown into one, give $\frac{abb+4aac}{4aaa}$ which divided by a, gives $\frac{bb+4ac}{4aa}$, therefore $xx-\frac{bx}{a}+\frac{4aa}{bb}=\frac{bb+4ac}{4aa}$.

Now let $bb+4ac=ss$, then the equation will ſtand thus, $xx-\frac{bx}{a}+\frac{bb}{4aa}=\frac{ss}{4aa}$, then per Rule 4, $x-\frac{2a}{b}=\frac{s}{2a}$. therefore, $x=\frac{b+s}{2a}$, that is, $x=\frac{b+s}{2a}$, or, $x=\frac{b-s}{2a}$

Q E. F.

EXAMPLES.

EXAMPLES.

1. Suppoſe $xx-4x=32$, what is the Value of x?
2. Suppoſe $12xx-420x=-1200$, quere x?
3. Suppoſe $4x^2+60x=216$, what is x equal to?

Suppoſe $a=21$, or any other Number, and $e=7$, the leſſer Number:

Then let

		their
$a+e=s=28$		Sum,
$a-e=d=14$		Difference,
$ae=p=147$		Product,
$\frac{a}{e}=q=3$		Quotient,
$aa+ee=z=490$		Sum of their Squares,
$aa-ee=x=392$		Differ. of their Squares.

Any two of theſe ſix Letters (s, d, p, q, x, z,) being given, to find the reſt; which admits of 15 Variations or Queſtions, and are thoſe which Mr. WARD has ſo excellently anſwered in his MATHEMATICIAN'S GUIDE.

Queſtion 1. Suppoſe s and d were given, and it were required by them to find a, e, p, q, z, and x.
2. Let s and p be given, to find the reſt.
3. Suppoſe s and q were given, to find the reſt.
4. Suppoſe s and z were given, to find the reſt.
5. Let s and x be given, to find the reſt.
6. Suppoſe d and p are given, to find the reſt.
7. Let d and q be given, to find the reſt.
8. Suppoſe d and z are given, to find the reſt.
9. Suppoſe d and x are given, to find the reſt.
10. Let p and q be given, to find the reſt.
11. Suppoſe p and z be given, to find the reſt.
12. Let p and x be given, to find the reſt.
13. Suppoſe q and z were given, to find the reſt.
14. Let q and x be given, to find the reſt.
15. Suppoſe z and x were given, quere the reſt?

Theſe fifteen Queſtions being purſued throughout, to find the Value of all the unknown Quantities, will afford a great Variety, and will be found to be of great Service to the Pupil, in the Solution of moſt Queſtions.

Note.

Note.—I would adviſe the Learner, to uſe the ſame Numbers, for the reſpective Value of each Quantity, throughout all the Queſtions, as they will be more ſatisfactory in proving the Work, than Various Numbers will be; not but any Number may be taken at Pleaſure, provided the Number repreſented by a be greater than that by e, &c.

The Pupil may make a Numerical Calculation in each Queſtion.

PROBLEMS.

1. What two Numbers are thoſe, whoſe Difference is 20, and whoſe Sum is 70?
2. What two Numbers are thoſe, whoſe Difference is 14, and the Quotient of the greater divided by the leſs is 3?
3. What Number is that, whoſe third Part, added to its fourth, will be 21?
4. What Number is that, whoſe third Part exceeds its fourth by 4?
5. What Number is that, whoſe third Part leſs 4, is equal to its fourth leſs, 25?
6. What Numbers are thoſe, whoſe Difference is 8, and the Difference of their Squares is 208?
7. What two Numbers are thoſe, whoſe Sum is 60, and the greater is to the leſſer, as 9 is to 3?
8. Find two Numbers, the Product whereof is 108, and the Triple of the greater divided by the leſſer is 4?
9. Find two Numbers, to whoſe Sum, if you add 8, the Whole will be double the greater, and if you ſubtract 4,5 from their Difference, the Remainder will be Half the leaſt?
10. Find three Numbers, ſo that the firſt, and half the Remainder, the ſecond and one-third of the Remainder, and the third and one-fourth the Remainder, may always make 34?
11. Divide 100 twice in two Parts, ſo that the major Part of the firſt Diviſion may be three Times the minor Part of the ſecond Diviſion, and the major Part of the ſecond may be double the minor Part of the firſt?
12. Three Perſons, A, B, and C, make a joint Contribution, which in the Whole amounts to 76*l.* of this A contributes

contributes a certain Sum unknown; B. as much as A. and 10*l.* more; and C. as much as both A. and B. together: I demand their ſeveral Contributions?

13. There are 480 Men to be placed in an Oblong, whoſe Length and Breadth together make 52: How many in each Side?

14. Sold a Quantity of Tobacco for 19*s.* Part of which at 1*s.* per Pound, and the Reſt at 15*d.* now the firſt Part was to the latter as $\frac{3}{4}$ to $\frac{2}{3}$: How much was ſold of each Side?

15. After paying away $\frac{1}{4}$ and $\frac{1}{3}$ of my Money, I found 66 Guineas left in my Bag: What was it at firſt?

16. What two Numbers are thoſe, whoſe Sum, multiplied by the greater, produces 77; and whoſe Difference, multiplied by the leſſer, gives 12?

17. What Number, from whoſe Double 10 being ſubtracted, the Square of the Remainder leſs 1 will be equal to 7 Times the ſaid Number?

18. A Father at his Death left, by his Will, 1000*l.* to be divided between his Son and Daughter, in ſuch a Manner that $\frac{1}{5}$ Part of his Share ſhould exceed $\frac{1}{6}$ Part of her's by 10*l.* how muſt the 1000*l.* be divided?

19. The continual Product of four Numbers in Arithmetical Progreſſion is 945, and the common Difference 2; what are thoſe Numbers?

20. If to my Months you ſhould add Half this Sum,
And one-eighth more, and then ſhould ſubtract one,
The Reſidue would ſuch a Number be
As twenty-one, being ſquared, aſſuredly?

21. Three Numbers in Geometrical Progreſſion are required, ſo that the Difference of the firſt and ſecond may be 6, and of the ſecond and third 15?

22. To find a Number, from the Cube of which if you ſubtract 19, and multiply the Remainder by that Cube, the Product ſhall be 216?

23. Sixty Thouſand brave Soldiers in Battle there were
Plac'd on a vaſt Plain, and in Form a long Square:
Now on how many Acres of Ground did they ſtand,
At two Yards three Quarters between Man and Man;
And how many in Rank and File will there be,
When their Breadth to their Length is as two is to three?

24. A General, diſpoſing of his Army into a ſquare Battle,

finds he has 284 Soldiers over and above, but increasing each Side with one Man, he wanted 25 to fill up the Square: Quere, the Number of Soldiers?

25. Old John, who had in Credit liv'd,
Tho' now reduc'd, a Sum receiv'd;
This lucky Hit's no sooner found,
Than clam'rous Duns came swarming round;
To th' Landlord—Baker—many more,
John paid in all, Pounds ninety-four.
Half what remain'd—a Friend he lent,—
On Joan and 'Self, one-fifth he spent;
And when of all these Sums bereft,
One-tenth o' th' Sum received had left;
Now shew your Skill, ye learned Youths,
And by your Work the Sum produce.

26. In a Rectangle, ABCD, is given the Difference between the Length, AB, and the Diagonal, BD, that is, DE=2; likewise the Difference between the Breadth, AD, the Diagonal, BD, that is, FE=9, required the Sides of the Rectangle, AB, AD?

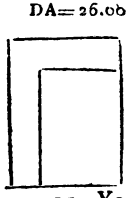
27. In a Triangle, ABC, the several Sides are given, viz. AB=13, AC=14, BC=15, and the Perpendicular AD being drawn, required the Segment of the Bases BD, DC?

28. Suppose the Plate of a Looking-Glass is 18 Inches by 12, and is to be framed with a Frame of equal Width, and whose Area is to be equal to that of the Glass, the Width of the Frame is required? Anf. 3.

29. One Morning in May I went to survey,
As soon as bright Sol I espy'd;
I measured round a four corner'd Ground,
The Margin's * the Length of each Side:
The Angle at B, together with D,
An hundred and fifty Degrees;
The Meadow's Content is all that I want,
Assist me, kind Youths, if you please?

* AB=15.60
BC=13.20
CD=10.00
DA=26.00

30. A Gentleman a Garden had,
Five Score Feet long, and four Score broad:
A Walk of equal Breadth, half round,
He made that took up Half the Ground:
The Figure in the Margin see,
How wide's the Walk? I pray tell me.



31. Ye

31. Ye young Artiſts be ſo kind
The Fences of a Field to find;
Triang'lar is the Form of Ground,
Its Area twice twelve Chains was found;
One at the Baſe I knew,
Juſt thirty-ſix and fifty-two;
And cub'd when every Side ſhall be,
The Sum you in the Margin ſee *. * 1728 Chains.

For more Examples, ſee Sect. 30 and 31.

A few diverting QUESTIONS.

1. A Cheſhire Cheeſe, when in one Scale, weighed 76lb. but on being changed into the other Scale, it weighed only 56lb. Quere, the true Weight? Anſ. 65,1965lb.

The general Rule for Queſtions of this Sort is, to multiply the two Weights together, and extract the Square Root of the Product, which Root will be the true Weight.

2. A Stone, weighing 40lb. is by Accident broken into four Pieces, by which may be weighed any Number of Pounds, from 1lb. to 40lb. Quere, the Weight of each Piece?

A General RULE for the Solution of QUESTIONS of this Nature.

To double the firſt or leaſt Weight, which always contains one Pound, add 1, and it gives the ſecond Weight.

Again, to double the Sum of theſe two Weights, add 1, it produces the third Weight: And again, to double the Sum of theſe three Weights, add 1, and we ſhall have the fourth Weight.

3. A certain Company being at a Public Houſe, their Reckoning came to 6*s.* ¼*d.* the Number of Perſons in Company were equal to the Farthings each ſpent: Quere, the Number in Company, and what each ſpent?

The General Rule to anſwer Queſtions of this Sort, is to reduce the given Sum to its loweſt Name mentioned, and of which extract the Square Root, which will be the Anſwer.

4. A Pack of Cards being laid into any Number of Heaps, ſo that the Spots on the bottom Card of each Heap, added to the Number of Cards laid thereon, may make 12, by giving the Number of Heaps, and of the Cards left out, to find the Number of Spots on all the bottom Cards?

QUESTIONS of this Nature are ſolved by the following Theorem:

Suppoſe n=the Number of Heaps,
r=the Number of Cards left,
w=the whole Pack,
x=the Number of Spots required.

Then the Theorem will be $13n-w+r=x$, the Number of Spots required.

Suppoſe a Pack of Cards be dealt into 7 Heaps, and then there is 12 Cards left out: Quere, the Number of Spots on all the bottom Cards?

5. What Dimenſions muſt I give to a Joiner to make a Cubical Box that will hold 2000 Oranges of $2\frac{1}{4}$ Inches Diameter each, ſuppoſing the Oranges globular, keeping that Form, and laid in Rows exactly at the Top of each other? Anſ. 31,498 Inches inſide.

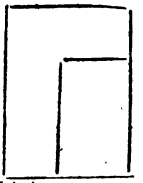
6. A Maſter Joiner gives to one of his Men a Plank that is 10 Feet by 2, with Orders to make of it a Square Table, equal in Area to the ſaid Plank, but not to exceed ſix Segments; the Poor Man being ignorant of Lines (and not willing his Maſter ſhould know it) would be greatly obliged to any who will draw the Plan how the ſaid Plank muſt be cut and applied together?

7. A Perſon being aſked what Hour of the Day it was, anſwered, It is between 5 and 6, and both the Minute Hand and Hour Hand are together: Required the Hour of the Day?

8. A Lady has a Dreſſing-Table, each Side of which is 27 Inches, but ſhe is deſirous to know how each Side of the ſame may =36 Inches, by having 4 Foot of Plank, ſuperficial Meaſure, joined to the ſame. The Plan in what Manner the Plank muſt be cut and applied to the Table is required?

9. A

9. A Gentleman purchaſes a Piece of Land in Form of a Parallelogram, and incloſes one-fourth Part (as per Figure) to build a Houſe and other Conveniencies upon; now he deſires the Remainder of this Land may be divided into four Parts, equal and ſimilar to each other, to be appropriated to ſuch Uſes as he ſhall hereafter think proper; the Plan is deſired?



10. Required to divide a given Trapezium, of two equal Parts, (Geometrically) by the ſhorteſt Line poſſible?

11. A Perſon, for a conſiderable Wager, is to travel from a Town A, to another B, but he is to call at a Place which is ſomewhere on the Line *a b*: Now his Time limited being very ſhort, he is deſirous to know (by Geometry) the Situation of the Place on the Line *a b*, the Diſtance from thence to A and B being the ſhorteſt poſſible.

12. All the different Ways poſſible in which a Gentleman can place his Servants, combining them by 1, 2, 3, &c. at a Time are 960799: What Number of Servants does he keep?

GENEALOGICAL PARADOXES.

1. Suppoſe two Women, and each a Son, were walking together, and were met by another Perſon, who aſked the Boys in what Relation they ſtood to each other; they replied, We are Sons and Grandſons by the Father; Brothers and firſt Couſins by the Mothers; who alſo are Aunts to each of us. This Combination of Kindred once happened, but in what Manner? See Gen. xix.

2. Who was he that was begot before his Father, born before his Mother, and had the Maidenhead of his Grandmother?

APPENDIX.

CONTAINING

Various Forms of Acquittances, Promiſſory Notes, Bills of Exchange, Letters of Advice, Letters of Credit, Bills of Parcels, and Bills on Book Debts, all of which are adapted to ſuch Circumſtances as occur in real Buſineſs, to enter a Pupil in the Manner and Method of Commerce, and to make him ready at Computation.

A general Receipt.

RECEIVED Auguſt 9th, 1784, of Mr. Anthony Buſkin, the Sum of Fifty Pounds, in full for one Quarter's Rent, due at Midſummer laſt, and of all Demands,

By me HENRY HEDGES.

£50 00 00

A Receipt or Acquittance for Rent paid.

Received this 5th Day of January, 1784, of Mr. Thomas Field, the Sum of Thirty-two Pounds Sixteen Shillings in Money, which with Eight Pounds Four Shillings more, diſburſed by the ſaid Thomas Field for Taxes and Reparations of the Meſſuage and Tenements he now occupies, ſituate

ſituate in Chiſwell-ſtreet, London, makes in the whole the Sum of Forty Pounds, and is in full of Half a Year's Rent due to me out of the ſaid Premiſes at Michaelmas Day laſt. —I ſay received by me,

£ 40 00 00 THOMAS ROSE.

An Acquittance for Debt received of a third Hand.

RECEIVED this 10th Day of July, 1784, of Mr. Joſeph Stanley, by the Hands of Mr. Clark Stanley, the Sum of Seven Pounds, in full for certain goods bought by the ſaid Joſeph Stanley of me.—I ſay, received in full of all demands, by me,

£ 7 00 00 FRANCIS CRUMP.

An Acquittance for Money received in Part of a Debt due on bond.

RECEIVED this 16th of June, 1784, of Mr. Thomas Brown, the Sum of Ten Pounds Ten Shillings and Six Pence, in Part of Payment of a greater Sum, due to me on Bond from the ſaid Thomas Brown.—I ſay, received by me,

£ 10 10 06 THOMAS HEDGES.

An Acquittance for Money received by a third Perſon for the Uſe of another.

RECEIVED this 18th Day of March, 1784, of Mr. Edward Hedges, the Sum of Twenty Pounds, in full for Work done by Charles Day, for the ſaid Mr. Edward Hedges. —I ſay, received by the Order, and for the Uſe of the ſaid Charles Day, by

£ 20 00 00 THOMAS WOOTTON.

A Re-

A Receipt for Intereſt due on Bond.

RECEIVED this 13th Day of January, 1784, of Mr. Abraham Brooks, the Sum of Five Pounds, in full for one Year's Intereſt, of 100*l.* due to me at Chriſtmas laſt, on Bond from the ſaid Abraham Brooks.—I ſay, received by me,

DAVID BURN.

£5 0 0

Note, Beſides theſe Receipts to be taken on Payment of Money due on Bonds, it is proper to have each Payment mentioned on the Back of the Obligation.

An Acquittance for a Legacy.

RECEIVED this 29th Day of July, 1784, of John Roberts, Executor of the laſt Will and Teſtament of Samuel Green, late of Weſtham, in the County of Eſſex, deceaſed, the Sum of One Hundred Pounds, in full of a Legacy bequeathed to me, in and by the laſt Will and Teſtament of the ſaid Samuel Green.——I ſay, received in full of all Demands, by me,

JOHN JARRETT.

£100 0 0

An Acquittance to an Adminiſtrator on Payment of a Debt due from the Inteſtate.

RECEIVED this 30th Day of July, 1784, of Mr. Wm. Jarrett, Adminiſtrator of the Goods and Chattels, Rights, and Credits of John Noon, late of Briſtol, in the County of Somerſet, deceaſed, the Sum of Three Hundred Pounds, in full of a Debt owing me by the ſaid John Noon in his Life-time, for Houſhold Goods by me ſold him.—I ſay, received in full of all Demands, by me,

£300 00 00 GEORGE CHINNER.

A Receipt proper to be taken upon a Perſon's giving a Promiſſory Note for a Book Debt.

RECEIVED this 20th Day of April, 1784, of Mr. Wm. Straight, a Promiſſory Note for the Sum of Sixty Pounds, payable to me or Order three Months after Date, which Sum when paid is in full of all Demands.—I ſay, received by me,

£60 00 00 THOMAS ROSS.

An Acquittance for the Purchaſe-Money on executing of a Conveyveyance, to be indorſed on the Back of a Deed.

RECEIVED the Day and Year within written, of the within named Thomas Biſſon, the Sum of Seventy Pounds, being the full Conſideration Money within mentioned to be paid to me.—I ſay, received by me,

£70 00 00 CHARLES BARRON.

Witneſs to the Payment of the Money.

A Re-

A Receipt for Writings entruſted in a Perſon's Hand.

RECEIVED this 25th Day of Nov. 1784, of John Stag, of Eye, in the County of Suffolk, four ſeveral Deeds or Conveyances; one of them purporting to be a Leaſe of a Meſſuage, ſituate in Narrow-ſtreet, Lime-Houſe, and made between John Lee of Wapping, and William Burt of Weſtminſter; another to be an Aſſignment of the ſaid Leaſe, and made between John Vyſe of New-ſtreet, London, and Felix Morgan of Bangor, in the County of Carnarvon; and the other to be a Leaſe and Releaſe, and made between John Jee of Barking, in the County of Eſſex, and John Bevan of Newhaven, in the County of Suſſex; for which ſeveral Deeds or Writings, I hereby promiſe to be accountable, and to re-deliver the ſame to the ſaid John Stag on Demand,

HENRY WRIGHT.

Witneſs my Hand,

The Form of Promiſſory Notes, or common Notes for Money.

The Form of one payable on Demand.

I PROMISE to pay to Anthony Wilſon or Order, the Sum of Twenty Pounds on Demand, for Value received. Witneſs my Hand this firſt of January, 1784.

HENRY WILSON.

£20 00 00

The Form of one payable at a certain Time.

London, January 4, 1784.

THREE Months after Date, I promiſe to pay to Mr. Aaron Brooks or Order, the Sum of Ten Pounds, for Value received by me,

CHARLES VYSE.

£10 00 00

Form

Form of one payable at ſundry Times.

I PROMISE to pay Sir Aaron Day or Order, the Sum of Thirty-ſix Pounds, in the Manner following: Ten Pounds, Part thereof, three Months after Date, Sixteen Pounds more the 20th of May next, and the remaining Ten Pounds the 27th of July next following, for Value received. Witneſs my Hand at London, the 2d of January, 1784.

JOHN COWCHEE.

£36 00 00

Form of one for Goods received.

I PROMISE to return John Whyley, Eſq. or Order, on Demand, one Caſket of Jewels, ſealed, One Hundred Ounces of Gold Plate, Three Hundred and Fifty of Silver ditto, One Hundred Carats of Oriental Pearl, and a Five Hundred Pound Bank Note.——Received of the ſaid John Whyley, Eſq. for Self and Company, March 4th, 1784, by me,

JAMES COWCHEE.

Form of Inland Bills of Exchange.

Form of one payable at Sight.

£100

Briſtol, January 14, 1784.

AT Sight pay Mr. John Barwick or Order, the Sum of One Hundred Pounds, the Value received of Mr. James Barwick, and place it to Account as per Advice from

WM. BARWICK.

To Mr. Charles Davis, at the Horſe-guards, Whitehall, London.

Form

Form of one payable after Sight.

£64 17 6

London, June 12, 1784.

AT Ten Days Sight pay Mr. William Straight or Order, the Sum of Sixty-four Pounds Seventeen Shillings and Six Pence, the Value received, for Thomas Johnſon, Eſq, and place it to Account as per Advice from

GEORGE DEAR.

To Mr. Thomas Lawr,
Clothier, Saliſbury.

Form of one payable after Date.

£70

Edinburgh, July 2, 1784.

THREE Months after Date pay Sir John Walker or Order, the Sum of Seventy Pounds, Sterling, Value in Ourſelves, and place it without more Advice to the Account of

THOMAS and JAMES BURN.

To Sir Thomas Biſſor.,
Lombard-ſtreet, London.

£40

London, Nov. 24, 1784.

Meſſrs. Fox and Payn,

PAY Thomas Stanley or Bearer, Forty Pounds on Account.

THOMAS PETTIT.

Another

Another.

SIR, York, June 4, 1784.

PAY Mr. Thomas Roſs, or Bearer, One Hundred Pounds, on Demand, and place it to my Account.

THO. CLIFFORD.

To Mr. John Hawkins,
Silverſmith Whitechapel.

Form of Foreign Bills of Exchange.

For Crowns 600 *at Uſance.*

London, July 12, 1784.

London on Paris. Firſt Bill. } At Uſance pay this Firſt of Exchange to Henry Gibbins or Order, Six Hundred Crowns for the Value here received of Samuel Drummond, and place it to Account, as per Advice from

JOHN PLAW.

To Mr. George Pain,
Merchant, at Paris.

For Crowns 600 *at Uſance.*

London, July 12, 1784.

Second Bill. } AT Uſance pay this my ſecond of Exchange, my firſt not paid, to Joſeph Lindman or Order, Six Hundred Crowns for the Value received of Sir George Wayer, and place it to Account, as per Advice.

THOMAS SWIFT.

To Mr. Robert Clifford,
Merchant, at Paris.

£602 15s. 3¾ Sterl. at 34d¾ per £. Sterl. Uſance.

London, Sept. 6, 1784.

London on Rotterdam. Firſt Bill.

AT Uſance pay this Firſt of Exchange to James Vyſe or Order, Six Hundred and Two Pounds Fifteen Shillings and Three Pence One Farthing Sterl. at Thirty-four Pence One Farthing Flem. per Pound Sterl. Value of Samuel Turner, Eſq. and place it as per Advice from

Your moſt humble Servant,

THOMAS WOOLDRIDGE.

To Mr. Samuel Cook, Merchant, at Rotterdam.

Form of a Factor's Remittance to his Employer.

For Crowns, 700 at 5s. 4d. Sterl.

Genoa, Sept. 6, 1784.

AT Twenty Days ſight pay this my firſt of Exchange to Thomas Godfrey or Order, Seven Hundred Crowns Exchange, at Fifty-four Pence per Crown, Value received of the Lords of the Regency, and place it to the Account of Mr. Wm. Stanes, of Lyons, as per Advice from him,

GEORGE WARD.

To Mr. Francis Baker, Banker, Lombard-ſtreet, London.

Mr. William Stanes's Letter, adviſing his Concurrence to the aforementioned Draught.

Lyons, Sept. 30, 1784.

SIR,

BROTHER George Ward, of Genoa, has this Day deſired me to furniſh him with Seven Hundred Crowns, payable

able to the Reſident of the States at London. I have therefore ordered him to draw for the ſaid Sum on you, which pleaſe to honour as uſual, and put it to the Account of

Your Friend and Servant,

WILLIAM STANES.

To Mr. Francis Baker, Banker, Lombard-ſtreet, London.

Form of a Draught on the Employer for Value of Goods ſhipped him per Factor.

Milrees 400 at Uſance

St. Andrews, June 24, 1784.

North Britain on Liſbon. } AT Uſance pay this my firſt of Exchange to Mr. Edward Roſs or Order, Four Hundred Milrees, the Value here ſhipped for your Uſe, upon the Santa Maria of Naples, and conſigned as per Advice from your very humble Servant,

MICHAEL GODFREY.

To Signior Santilena, at Liſbon.

Form of an Employer's Letter with Remittance to his Factor, in a Bill of the ſaid Factor's Correſpondent.

Mr. Thomas Dale,

ACCORDING to your Deſire I have remitted you Four Hundred Crowns for my Accompt, in your Correſpondent Baker's Bill incloſed, payable by and to yourſelf, for which pleaſe to give me credit; I recommend the Contents of my laſt and the 4th Current to you, and reſt your Friend and humble Servant,

EDWARD BAKER.

Paris, Sept. 14, 1784.

For Crowns 400, at 34d. per Crown.

Paris, Sept. 14, 1784.

The Bill. AT double Uſance pay this my only Bill of Exchange to myſelf, the Sum of Four Hundred Crowns, Exchange at Thirty-four Pence, Sterl. per Crown, the Value received of Monſ. Edward Baker, and place it as per Advice to to the Accompt of

Your humble Servant,

HENRY VYSE.

To Thomas Day, Merchant, at Briſtol.

Form of the Correſpondent's Letter of Advice.

Mr. Thomas Day,

SIR, Paris, Sept. 14, 1784.

BY this Poſt I have drawn on you for Four Hundred Crowns, at 34d. payable to yourſelf, Value of Monſ. Edw. Bakerman, which with my other Bills depending pleaſe to honour, and the timely Remittance ſhall be punctually made you by

SIR,

Your very humble Servant,

NICHOLAS BROWN.

To Mr. Timothy Bevan, Merchant, Briſtol.

Form

Form of Letters of Credit.

SIR, London, June 12, 1784.

PLEASE to furniſh the Bearer hereof, Mr. Thomas Cavendiſh, with the Sum of One Hundred Pounds, as he ſhall require the ſame, and place it to my Account, for which this Letter of Credit, with his Receipt, ſhall be your ſufficient Voucher and Warrant, giving upon Payment a Line or two of Advice to

Your real Friend,

FRANCIS ROSS.

To Mr. John Day, Merchant, at Hull.

The Receipt.

RECEIVED July 6, 1784, of Mr. Robert Berry, the Sum of One Hundred Pounds, by Virtue of Mr. Francis Roſs's Letter of Credit of June 12th laſt, for the ſaid Sum, per

MICHAEL NICHOLS.

£.100 0 0

Dublin, May 7, 1784.

SIR,

THE Bearer, Mr. Thomas Vyſe, will have Occaſion for Sixty Pounds, which Sum I deſire you to furniſh him, and take his Bill for the ſaid Sum, or any Part thereof, on the Honourable William Webb, Eſq.

I am, Sir,

Your humble Servant,

RICHARD KIRK.

To Henry Hedges, Eſq. Fleet-ſtreet, London.

Exch. £70

SIR, June 4, 1784.

The Bill. AT Twelve Days Sight pay this my Firſt of Exchange to Henry Hopkins, Eſq. or Order, the Sum of Seventy Pounds, the Value received of Ditto for your Uſe, as per Advice from, Sir,

Your humble Servant,

THOMAS VILE.

To the Hon. William Bay, Eſq. Dublin.

Exch. £70.

SIR, June 4, 1784.

AT Twelve Days Sight pay this my Second of Exchange, my firſt not paid, to Richard Kirk, Eſq. or Order, the Sum of Seventy Pounds, the Value received for your Uſe, of Henry Hopkins, Eſq. as by Advice from

Your humble Servant,

THOMAS WILKS.

To the Hon. William Bay, Eſq. Dublin.

Form of a general Letter of Credit, to furniſh a Perſon according to his Occaſion.

SIR, Paris, May 12, 1784.

THE Bearer, Mr. Aaron Babel, one of his Britannic Majeſty's Meſſengers, being ordered to Conſtantinople, will have Occaſion for Money to defray his Charges, &c. Pleaſe to furniſh him with the Sums he ſhall require at the ſaid Place, taking his Receipts, and your Draught for the Value ſhall receive due Honour from

Your humble Servant,

MICHAEL WELLS.

Monſ. Carter Day, Banquier, a Vienna.

For

For 600 at Liv. 31. 4s.

SIR, Vienna, June 2, 1784.

AT Three Days Sight pay this my only Bill of Exchange, to Edward Fay or Order, the Sum of 600 Florins, Exchange at three Livres four Sols per Florin, the Value paid at Conſtantinople to Aaron Babel, purſuant to your Letter of Credit of the 12th of May laſt, and as by Advice from the ſaid Aaron Babel.

RICHARD STANES.

A Monſ. Henry Hedges,
Banquier, a Paris.

Bills of Parcels, and Book Debts.

(1.) Mr. A. B.

Bought of THOMAS GROCER, Jan. 2, 1784.

		s.	d.		£.	s.	d.
4lb. of Green Tea,	at	17	6	per lb.			
121b. of Bohea,		7	10½	— —			
5 Hundred of Tobacco,		6	0	per C.			
10 Barrels of Raiſins		66	4	per B.			
9lb. of Pepper		2	9	per lb.			
7lb. of Brimſtone,		1	8½	— —			
8lb. of Coffee,		12	9	— —			
77oz. of Mace,		1	6½	— —			
					£.		

(2.) Mrs.

(2.) Mrs. T. G.

Bought of THOMAS SILK-MERCER, Jan. 7, 1784.

		s.	d.		£.	s.	d.
20 Yards of Brocaded Sattin,	at	17	9	per Yd.			
36 Yards of Mohair,	— —	10	8	——			
86 Ditto of Green Silk Damaſk,		19	11½	——			
100 Ditto of Paduaſoy,	— —	11	10	——			
9 Ditto of double Taffaty,	—	3	9	——			
12 Yards of ditto,	— —	5	6	——			
6 Yards of ditto,	— —	9	11½	——			
42 Yards of ditto,	— —	10	6	——			
					£.		

(3.) The Hon. Lady B.

Bought of J. LINEN-DRAPER, Jan. 6, 1784.

		s.	d.		£.	s.	d.
80 Ells of Dowlaſs,	at	0	11½	per Yd.			
96 Ells of Holland,	—	5	7½	——			
19½ Ells of Diaper,	—	1	7	——			
27½ Yards of Damaſk,	—	4	10½	——			
12 Yards of Muſlin,	—	11	0	——			
24½ Ells of Cambric,	—	5	6	——			
					£.		

(4.) Madam B.

Bought of B. MILLINER, Jan. 4, 1784.

	s.	d.		£.	s.	d.
26¼ Yards of blue Ribbon, at	2	6	per Yd.			
12 Fans, French Paper Mount,	4	9	each.			
6 Pair of Roman Gloves,	9	6	per Pr.			
4 Dozen of Iriſh Lamb ditto	1	10½	——			
6 Sarſenet Hoods, white,	5	11	each.			
A Piece of Mechlin Lace, 12¼ Y.	17	6	per Yd.			
				£.		

(5.) Mrs.

(5.) Mrs. F. PINDUST,

Bought of THOMAS HOSIER, July 12, 1784.

		s.	d.		£.	s.	d.
28	Pair of Thread Stockings, at	4	6	per Pr.			
1½	Dozen of Worſted, mixt,	3	10	——			
18	Pair of Strawberry Hoſe,	4	0	——			
16	Pair of Silk Gloves, —	5	11½	——			
74	Pair of Norwich Hoſe, —	2	6	——			
17	Pair of Mens Yarn, —	3	0	——			
11½	Dozen ditto, Silk, — —	16	6	——			
					£.		

(6.) Mrs. ANN SCOTT,

Bought of JOHN FRUITERER, May 7, 1784.

		s.	d.		£.	s.	d.
6	Dozen of Lemons, at	2	10	per Doz.			
4½	Hundred of Liſbon ditto	6	6	per Hun.			
10	Ropes of Onions, —	1	9	each.			
17	D. Seville and China Oranges,	4	6	per Doz.			
A	Buſhel of Cheſnuts, —	—		—		10	6
6	Dozen of Pomegranates,	4	10				
					£.		

(7.) Mr. C. TOMS,

Bought of Mr. JAMES DRAPER, Feb. 4, 1784.

		s.	d.		£.	s.	d.
12⅞	Yards of Broad Cloath, at	18	6	per Yd.			
17	Yards of fine Spaniſh black,	17	4	——			
14⅝	Yards of fine Grey Cloth,	16	10	——			
6½	Yards of ſecond Drab, —	12	8	——			
27¼	Yards of Shalloons, —	1	9	——			
19	Yards of Serge, — —	4	10½	——			
					£.		

(8.) Mr.

(8.) Mr. W. L.

Bought of ANDREW OILMAN, March 7, 1784.

			s.	d.		£.	s.	d.
12lb. of Anchovies,	at		1	6	per lb.			
6½lb. of Capers,	—	—	0	11½	—			
26lb. of Salt,	—	—	0	9¾	—			
4 Gallons of pickled Muſhrooms,			3	6	per gal.			
3 Gallons of Lucca Oil,	—		10	6	—			
12lb. of Salt-Petre,	—	—	1	4¾	per lb.			
						£.		

(9.) JOHN JONES, Eſq.

Bought of THO. CHEESEMONGER, Jan. 16, 1784.

	C.	qr.	lb.		s.	d.	
6 Old Cheſhire Cheeſes, Wt.	3	2	14	at	44	6	per C.
3 Glouceſterſhire ditto,	2	3	21		36	4	
8 Flitches of Bacon, —	50 Stone			—	2	11¼	per St.
10 Firkins of Butter, —	—		—		32	6	each.
24 Stilton Cheeſes, —	6	2	9		37	10	per C.
3 Weys of Suffolk Butter,	—		—		132	6	each.
						£.	

(10.) Sir MATTHEW LAMB,

Bought of NATH. WINE-MERCHANT, Oct. 4, 1784.

		s.	d.		£.	s.	d.
12¾ Dozen of Claret Wine,	at	37	6	per Doz.			
4 Gallons of Canary,	—	9	6	per Gal.			
2 Hhds of old Mountain,		6	4	—			
26 Dozen of Madeira,	—	30	6	per Doz.			
12 Dozen of Tent,	—	59	10	—			
4¼ Dozen of Red Port,	—	19	10	—			
					£.		

(11.) Mrs.

(11.) Mrs. B.

1784. Bought of J. BUTCHER.

		lb.	*d.*	*£.*	*s.*	*d.*
Jan. 2.	A fore Quar. Lamb, wt.	10¼	at 4½ per lb.			
29.	Ditto of Pork, —	14	5 —			
Feb. 4.	A Buttock of Beef, —	49	4½ —			
10.	A Fillet of Veal, —	11½	5½ —			
27.	A Surloin of Beef,	26	4½ —			
Mar. 6.	Beef Steaks, —	10	5½ —			
14.	A Saddle of Mutton.	17¼	4¾ —			
				£.		

(12.) JOHN THOMAS,

Bought of J. CORN-CHANDLER, March 4, 1784.

		s.	*d.*		*£.*	*s.*	*d.*
4 Quarters of Barley,	at	16	9	per Quar.			
12 Bushels of Wheat,	—	5	9	per Bush.			
7 Ditto of Oats, —	—	11	9	per Quar.			
20 Bushels of Beans,	—	4	6	per Bush.			
18lb. of Hops, —	—	1	9	per lb.			
4 Loads of Hay, —	—	50	0	per Load.			
					£.		

(13.) Sept. 6, 1784,

Mr. Jones, Dr. To J. COAL-MERCHANT.

			s.	*d.*		*£.*	*s.*	*d.*
Feb. 17.	4	Sacks of Coals, at	39	6	per Ch.			
Mar. 4.	5½	Chaldrons of ditto,	30	0	—			
16.	8	Sacks of ditto,	34	6	—			
27.	9	Sacks of ditto,	42	0	—			
Apr. 6.	7	Sacks of ditto,	38	9	—			
20.	3	Sacks of ditto,	45	0	—			
						£.		

(14.) THOMAS

(14.) THOMAS JOHNSON,

Bought of JOHN GROCER, June 27, 1784.

		C.	q.	lb.		s.	d.	£.	s.	d.
12 Hhds of Tobacco,	wt.	6	1	24	at	53	6			
9 Barrels of Raisins,	—	2	3	20		39	8			
12 Ditto of Rice,	—	3	1	27		26	11			
8 Bags of Pepper,	—	1	3	14		79	6			
Brimstone,	—	3	2	24		27	6			
4 Hhds of Sugar,	—	4	1	17		33	9½			
								£.		

(15.) MR. JOHN MAN,

Bought of JOHN JEE, Aug. 27, 1778.

6 Casks of Barbadoes Sugar, at 2 Months credit, viz.

			C.	q.	lb.		q.	lb.
No. 1.	——	wt.	10	0	24	Tare	3	10 each.
2.	——	—	9	2	17			
3.	——	—	8	3	20			
4.	——	—	11	2	17			
5.	——	—	10	1	1			
6.	——	—	9	3	19			
	Gross,							
	Tare,							
	Neat,					at 53*s.* 6*d.* per Cwt.		

(16.) Mr.

(16.) Mr. JOHN ROSS,

Bought of JOHN MACKINDER, Aug. 30, 1778.

	C.	q.	lb.	s.	d.		£. s. d.
8 Hhds of Sugar, Groſs	10	3	10				
Tare	0	2	10	at 74	0	p. C.	
2 Bar. of Scotch Snuff, Gr.	8	2	7				
Ta.	0	2	7	at 1	6	p. lb.	
2 Ditto of Pimento, Gr.	7	3	7				
Ta.	0	2	2	at 1	10	—	
3 Ditto of Figs, Gr.	8	2	11				
Ta.	0	1	27	at 30	0	p. C.	
4 Hhds of Treacle, Gr.	11	2	19				
Ta.	0	2	27	at 14	10	—	
8 Ditto of Prunes, Gr.	10	1	11				
Ta.	0	2	25	at 17	6	—	
							£.

(17.) Mr. THOMAS BAIL,

Bought of JOHN SILVERSMITH, June 3, 1784.

	oz.	dwt.	gr.	s.	d.		£. s. d.
A Silver Tankard, wt.	14	2	3	at 6	9	per oz.	
— —— Punch Ladle,	0	19	20	at 7	2	——	
— —— Punch Bowl,	24	1	7	at 7	6	——	
A Pair of Silver Sauce-boats,	40	11	10	at 7	10	——	
6 Cruet Tops, —	4	9	3	at 6	4	——	
2 Sauce-Pans, —	62	19	4	at 7	2	——	
1 Doz. of Diſhes, each	26	14	6	at 6	2	——	
Ditto of Plates,	14	10	9	at 6	8½	——	
							£.

FINIS.

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